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Fish

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

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DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

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ZOOLOGY—VOL. XXIII.

PART LXV.—REPORT ON THE PTEROPODA—THE THECOSOMATA

By PAUL PELSENEER, D.Sc.

Published by Order of Her Majesty's Government

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE

AND SOLD BY

LONDON:—EYRE & SPOTTISWOODE, EAST HARDING STREET, FETTER LANE

EDINBURGH:—ADAM & CHARLES BLACK

DUBLIN:—HODGES, FIGGIS, & CO.

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EDITORIAL NOTE.

THE First Part of the Report on the PTEROPODA, by Dr. Paul Pelseneer, treating of the GYMNOSOMATA, was published in 1887 in Volume XIX., and forms Part LVIII. of the Zoological Series of Reports.

This Second Part of the Report, by the same author, deals with the THECOSOMATA, and contains 132 pages of letterpress and 2 plates, in addition to woodcuts. The translation from the French was made by Mr. J. Arthur Thomson, M.A. The Manuscript was received by me on the 2nd August 1887.

JOHN MURRAY.

CHALLENGER OFFICE, 32 QUEEN STREET,
EDINBURGH, *9th May* 1888.

ERRATA.

Page 107, line 9, for "*globulosa*" read "*gibbosa.*"

Page 112, line 18, add "*Cuvierina columella.*"

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the PTEROPODA collected by H.M.S. Challenger during the Years 1873-76. By PAUL PELSENEER, D.Sc. (Brussels).

PART II.—The THECOSOMATA.

INTRODUCTION.

ABOUT the end of the year 1885 I was entrusted with the task of making a systematic and descriptive Report on the Gymnosomatous Pteropods and an anatomical one on the entire order, and in the beginning of the present year (1887) the entire Report on the Pteropods was entrusted to me for completion.

The Report is thus divided into three portions as follows :—

1. The systematic survey of the Gymnosomata, which has been already published.[1]

2. The present Report on the Thecosomata, which along with the former includes the entire systematic survey of the Pteropods collected on the Challenger Expedition.

3. The anatomy of the Thecosomata and Gymnosomata.

As with the Gymnosomata, so in regard to the Thecosomata, I have been forced to make a monographic study of the entire subgroup. But I have not here described all the species actually known, partly because they are on the whole more familiar than the Gymnosomata, and partly because the delay which has been involved in the completion of the entire Report made such a survey impossible. I shall therefore restrict myself to an enumeration of the indubitably genuine species among the entire list of those hitherto described, and to synoptic tables in which these are distinguished from one another.

[1] Zool. Chall. Exp., part lviii.

And as to the species collected on the Challenger Expedition, I shall not describe those which are already sufficiently well known, and in regard to which there is no manner of doubt or dispute. I shall restrict my descriptions to the doubtful or imperfectly known species, attempting at the same time to make their systematic arrangement more lucid and less complex.

It is a noticeable fact that in general works on the systematic relations of Molluscs, the diagnoses of the families and genera of Pteropods are always the same, and that from a comparatively ancient date, just as if they had been verbally copied by successive authors. And since they have not been modified with the progress of research, the result is that they are often incorrect. I have therefore taken particular care with the diagnoses of families and genera, and have based these on specimens which I have myself studied. The diagnoses I have framed as simply and methodically as possible.

My monographic study of the subgroup Thecosomata has been based upon the following collections :—

1. The dry and preserved specimens in the British Museum.
2. The dry shells of Thecosomata in the Brussels Museum.
3. The Thecosomata collected on the "Triton" expedition.
4. The Thecosomata collected by Mr. John Rattray, F.R.S.E., during the cruise of the steamship "Buccaneer" on the western coast of Tropical Africa (1885–86).
5. The Thecosomata collected by the Italian vessel "Vettor Pisani" during the scientific expedition round the world (1882–85).
6. The Pteropods captured by Surgeon David Bruce, M.B., near Malta (1886).
7. The Thecosomata collected at the Zoological Station at Naples during my stay there (from February to July 1887).

I must also gratefully acknowledge my indebtedness to Mr. Edgar A. Smith, of the Zoological Department of the British Museum, from whom I have received much assistance, to Professor Ch. Vélain, of Paris, and to Mr. W. H. Dall, of the U.S. National Museum.

After enumerating the species I shall discuss the geographical distribution of the group. The phylogenetic relations of the different genera can only be satisfactorily discussed after some treatment of the anatomy, and will therefore be discussed in the anatomical Report.

The Habits of the Thecosomatous Pteropods.

I have nothing to add here either in regard to the history of the group or the differences between the two subdivisions. The subject has been sufficiently discussed in the Introduction to my Report on the Gymnosomatous Pteropods.[1]

[1] Zool. Chall. Exp., part lviii. pp. 1–6.

So too in regard to the habits of the Thecosomata. Like the Gymnosomata they are pelagic Molluscs, which descend to a certain depth to avoid bright light, and reascend when the light is feeble or absent, and when the sea is calm. They feed mainly on Protozoa (Radiolaria, Foraminifera, Infusoria) or on lower Algæ, while the Gymnosomata prey upon decidedly higher animals. This difference of diet is the condition effecting the notable diversity in the structure of the alimentary system, and especially of the buccal and stomachic armature.

The Thecosomata of the Challenger Expedition.

The Thecosomatous Pteropods collected on the Challenger Expedition, which form the material bases of the present Report, comprise two distinct series :—

1. The Thecosomata captured alive in the tow-nets, and preserved in alcohol or in microscopic preparations mounted in Canada balsam or in glycerine. These were entrusted to me towards the end of 1885 for use in my Report on the anatomy of the group.

2. The dry shells from deep-sea deposits, the importance of which will be discussed in the special report on the sea-bottom. This collection was selected from the deposits in the Challenger Office and also by Mr. Alfred E. Craven, who at one time proposed to write the Conchological Report on this group. It passed into my hands in the beginning of 1887, when a large number of the specimens had been already assorted.

I. The Thecosomata taken alive were gathered from seventy stations, and include twenty-eight species representing all the known genera. Among these species there is no new form, though a certain number have been hitherto insufficiently known or only once recorded.

The following table indicates the distribution of these species among the different genera.

Limacina, ...	6
Peraclis, ...	1
Clio, ...	10
Cuvierina, ...	1
Cavolinia, ...	8
Cymbulia, ...	1
Gleba, ...	1
that is, among 7 genera, ...	28 species.

II. The Thecosomata dredged from the deposits of the deep sea occur in all those known by the title "Pteropod ooze," and also in others. I have received the

shells from the sediments of twenty-one stations most rich in Thecosomata. The results of the study of these shells are detailed in this Report under the title of "Deposit-shells."

In the different shell-containing sediments which I have examined, I have found twenty-four species of Thecosomata, of which a dozen occur in considerable abundance at many of the stations. One of these forms is quite new. The various forms are distributed as follows in the different genera—

Genera.	Species previously known.	New Species.
Limacina, ...	6	...
Peraclis, ...	1	1
Clio, ...	8	...
Cuvierina, ...	1	...
Cavolinia, ...	7	...

Besides these twenty-four species there are five which do not occur in the Challenger collection of preserved Thecosomata. The total number of Pteropoda Thecosomata thus amounts to thirty-three, of which one is new, and a number either insufficiently known or not previously figured.

Limacina, ...	8
Peraclis, ...	2
Clio, ...	12
Cuvierina, ...	1
Cavolinia, ...	8
Cymbulia, ...	1
Gleba, ...	1
that is, in 7 genera, ...	33 species.

DESCRIPTION OF GENERA AND SPECIES.

PTEROPODA, Cuvier.

THECOSOMATA, de Blainville.

Pterocephala, Wagner, 1885.[1]
Eupteropoda, Boas, 1886.[2]

THE GENERA AND FAMILIES OF THECOSOMATA.

In the Systematic Report on the Gymnosomatous Pteropods, I have noted a number of genera formerly included in the group Pteropoda, but which ought long ago to have been relegated elsewhere.

Among the Thecosomata too, a number of forms have been rather recently included which do not belong to the group of Pteropods. Such are, for instance, *Cheletropis* and *Sinusigera*, which are really larvæ of Streptoneural Gastropods, whose velum has been mistaken for a fin;[3] and as to *Halopsyche* (*Euribia* and *Psyche*), it is one of the Gymnosomata, as I have noted in my previous Report.

But even after abstracting the names of genera which ought without hesitation to be removed from the systematic nomenclature of Thecosomata, there remains a long list of titles, which have been invented for living forms really belonging to the Thecosomata, but of which the majority cannot be retained. Such titles are proportionately more numerous than the generic names established for the Gymnosomata, and this because the generic diagnoses of the Thecosomata have been almost always based upon the shell. To this, which is nothing more than a simple ectodermic secretion, conchologists have attached too much systematic importance. There are indeed certain subgroups of Thecosomata, including a number of generic titles, greater than that of the genuine species.

[1] Die Wirbellosen des weissen Meeres, Bd. i. p. 119.

[2] Spolia atlantica, p. 179.

[3] Gastropods of the family of Cæcidæ also have long been considered as Thecosomatous Pteropods, under the title *Odontidium*.

Against such a tendency it is necessary to protest and to revert to a less rigid conception of what constitutes a genus, and though one does attach considerable systematic importance to the shell, this must not be exaggerated so as to lead to the erection of a separate genus for species which differ in some minute feature in the shell, but agree with one another in the rest of their characters. In addition to several differences of some importance in regard to the shells, it will be necessary to justify the establishment of a genus by at least one characteristic difference either in the soft structure of the animal, or in certain hard parts like the operculum or the buccal armature, which are generally of real importance in generic and specific diagnoses.

From this it follows that a large number of the generic titles discussed below must either be abandoned or regarded as synonyms. Some of them again may be considered as designating generic subdivisions, though these are not in any way indispensable in so comparatively small a group as the Thecosomata.

I shall append, from the literature of the group, an alphabetical list of the various generic names given to living Thecosomata :—

Agadina, Gould.
Archonta, Montfort.
Balantium, Leach.
Campylonaus, Gray.
Cavolinia, Abildgaard.
Cleodora, Péron and Lesueur.
Clio, Linné.
Corolla, Dall.
Creseis, Rang.
Cuvieria, Rang, *non* Péron.
Cuvierina, Boas.
Cymbulia, Péron and Lesueur.
Diacria, Gray.
Embolus, Jeffreys.
Euromus, H. and A. Adams.
Gleba, Forskål.
Heliconoides, d'Orbigny.
Helicophora, Gray.
Heterofusus, Fleming.
Hyalæa, Lamarck.
Hyalocylis, Fol.
Limacina, Cuvier.
Orbignyia, A. Adams.
Peracle, Forbes.
Pleuropus, Eschscholtz.
Protomedea, O. G. Costa.
Rheda, Humphreys.
Scæa, Philippi.
Spiratella, de Blainville.
Spirialis, Eydoux and Souleyet.
Styliola, Lesueur.
Tiedemannia, delle Chiaje.
Tricla, Oken, *non* Retzius.
Triptera, Auctorum, *non* Quoy and Gaimard.

Of these thirty-four titles

I. Two ought to be provisionally set aside as doubtful, for reasons which I shall afterwards submit :—

Agadina, Gould. | *Triptera*, Quoy and Gaimard.

II. Twenty-five are duplicates, and ought therefore to be retained simply as synonyms of Thecosomatous genera :—

Archonta, Montfort, . .	= *Cavolina*, Abildgaard.
Balantium, Leach, . .	= *Clio*, Linné.
Campylonaus, Gray, . .	= *Peraclis*, Forbes.
Cleodora, Péron and Lesueur, .	= *Clio*, Linné.
Corolla, Dall, . .	= *Gleba*, Forskål.
Creseis, Rang, . .	= *Clio*, Linné.
Cuvieria, Rang, . .	= *Cuvierina*, Boas.
Diacria, Gray, . .	= *Cavolinia*, Abildgaard.
Embolus, Jeffreys, . .	= *Limacina*, Cuvier.
Euromus, Adams, . .	= *Peraclis*, Forbes.
Heliconoides, d'Orbigny, .	= *Limacina*, Cuvier.
Helicophora, Gray, . .	= *Limacina*, Cuvier.
Heterofusus, Fleming, .	= *Limacina*, Cuvier.
Hyalæa, Lamarck, . .	= *Cavolinia*, Abildgaard.
Hyalocylis, Fol, . .	= *Clio*, Linné.
Orbignyia, A. Adams, .	= *Cavolinia*, Abildgaard.
Pleuropus, Eschscholtz, .	= *Cavolinia*, Abildgaard.
Protomedea, O. G. Costa, .	= *Limacina*, Cuvier.
Rheda, Humphreys, . .	= *Cavolinia*, Abildgaard.
Scæa, Philippi, . .	= *Limacina*, Cuvier.
Spiratella, de Blainville, .	= *Limacina*, Cuvier.
Spirialis, Eydoux and Souleyet,	= *Limacina*, Cuvier.
Styliola, Lesueur, . .	= *Clio*, Linné.
Tiedemannia, delle Chiaje, .	= *Gleba*, Forskål.
Tricla, Oken, . . .	= *Cavolinia*, Abildgaard.

As to the genus *Valvatina*, Bornemann,[1] Fischer[2] is evidently in error in stating that it includes living Pteropods, for all the forms which he describes are fossils. It is likewise probable that most of the latter are not even Pteropods.

The genera *Euchilotheca*, Fischer; *Flabellulum*, Bellardi; *Gamopleura*, Bellardi; *Poculina*, Bellardi; *Tibiella*, Meyer, and the genus *Valvatina* mentioned above are only known as Tertiary fossils; and they are further very closely allied to various extant genera.

I completely abstract certain primary fossils usually referred to the Pteropoda. I

[1] Die microscopische Fauna des Septarienthones von Hermsdorf bei Berlin, *Zeitschr. d. deutsch. geol. Gesellsch.*, Bd. vii. p. 18.

[2] Manuel de Conchyliologie, p. 430.

have a deep conviction that these organisms do not really belong to the group in question, and am firmly of opinion that Pteropods do not occur as fossils till the end of the Lower Tertiary. I shall afterwards revert more explicitly to this point in the anatomical part of the Report, in connection with the origin and phylogeny of the group.

Among the living Thecosomata really known there are, then, strictly speaking, only eight genera, including one new genus established in this Report.

These genera are :—

Limacina, Cuvier.	*Cavolinia*, Abildgaard.
Peracle, Forbes.	*Cymbulia*, Péron and Lesueur.
Clio, Linné.	*Cymbuliopsis*, n. gen.
Cuvierina, Boas.	*Gleba*, Forskål.

The following table indicates the chief diagnostic characters :—

Key to the Genera.

I. Calcareous shell quite outside the mantle.
  1. Shell twisted into a spiral.
    A. Shell with somewhat gentle whorls, a moderately wide opening, and a columella not prolonged into a recurved rostrum, ... *Limacina.*
    B. Shell with rapidly ascending whorls, with a very wide opening and a columella prolonged into a recurved rostrum, ... *Peraclis.*
  2. Shell straight and bilaterally symmetrical.
    A. Shell larger at the aperture than just behind.
      a. Shell without constriction behind the aperture, . . . *Clio.*
      b. Shell with a constriction immediately behind the aperture, . . *Cuvierina.*
    B. Shell narrower at the aperture than just behind, ... *Cavolinia.*

II. Cartilaginous shell covered by the pallial epithelium.
  1. Voluminous shell with a marked cavity.
    A. Thick shell, with the cavity not extending dorsally to the very end, . *Cymbulia.*
    B. Shell with thin walls, cavity extending dorsally to the very end, . . *Cymbuliopsis.*
  2. Flattened shell with almost no cavity, ... *Gleba.*

As to the relations of these eight genera with the other Pteropods, we have already noted in the Systematic Report on the Gymnosomata,[1] that Fol doubts whether *Cymbulia* has not more affinity with the Gymnosomata than with the Thecosomata. Wagner also separates the genus *Cymbulia* from the Thecosomata, and in order to get over the difficulty without solving it, creates for these animals a third division among the Pteropods, viz., Alata.[2]

In reality the members of the genus *Cymbulia* do not differ from the typical Thecosomata which Souleyet included in his family "Hyales" except in external appearance.

[1] Zool. Chall. Exp., part lviii. p. 6.

[2] Die Wirbellosen des weissen Meeres, Bd. i. p. 119.

In their entire organisation (existence of a pallial cavity; number of tentacles; position of the penis, fins, cerebral ganglia, &c.) they agree with the Thecosomata, as we shall see in our anatomical Report. On the other hand, their special characters make it convenient to erect for them a special family, which appears to be a far preferable course to uniting them, as Woodward[1] has done, with the Cavoliniidæ, in which he has also included the Gymnosomatous *Halopsyche*.

As to the other Thecosomata, they form a more uniform group, within which one may pass from one form to another without remarking any very considerable modification. It is true, however, that in this group some forms differ from the majority in having the shell twisted into a spiral, as also in the position of the anus and of the pallial cavity. The existence of these last two differences in forms otherwise closely allied will be explained in the anatomical part of the Report. The differences just mentioned make it possible to separate the forms in question, and to erect them into the family Limacinidæ, which, however, Souleyet unites with the typical Thecosomata.[2]

As to all the rest, they form a most natural family—Cavoliniidæ, from which there is no reason to separate the genus *Cuvierina*, under the name of Tripteridæ, as Gray[3] and the brothers Adams[4] have done. The last mentioned genus in fact differs but very slightly from certain types of Cavoliniidæ, such as the species of *Clio* of the section *Creseis*, from which indeed they are distinguishable only by the presence of a partition towards the middle of the shell, and by the constriction behind the aperture.

Among the Thecosomatous Pteropods, we thus recognise only three families:—

1. Limacinidæ, including the genera *Limacina* and *Peraclis*.
2. Cavoliniidæ, „ „ *Clio*, *Cuvierina*, and *Cavolinia*.
3. Cymbuliidæ, „ „ *Cymbulia*, *Cymbuliopsis*, and *Gleba*.

Family I. Limacinidæ.

1847. *Limacinidæ*, Gray, A List of the Genera of Recent Mollusca, their synonyms and types, Proc. Zool. Soc. Lond., p. 203.
1859. *Spirialidæ*, Chenu, Manuel de Conchyliologie, t. i. p. 113.

Characters.—Shell external, twisted into a left-handed spiral, with a spiral operculum. Animal with a dorsal pallial cavity, and a ventral columellar muscle; anus situated on the right side.

Description.—The shell, which is always delicate as in other pelagic animals, is of small size, and is translucent with slight colouring. The spire and the operculum differ considerably in form in the various species.

[1] A Manual of the Mollusca, p. 204, 1856. [2] Histoire naturelle des Mollusques Ptéropodes, p. 32.
[3] Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 23.
[4] The Genera of Recent Mollusca, vol. i. p. 54.

The operculum is very delicate, glassy, and transparent. It is fixed by a portion of its surface to the posterior face of the ventral lobe of the foot.

The animal is twisted like the shell which it completely fills, and into which it may be completely retracted. The margin of the mantle bears, on the right-hand side, and somewhat ventrally, a long extensile appendage. The posterior lobe of the foot, which bears the operculum and is topographically ventral, is hollowed out on the middle of its free margin. The fins do not exhibit, towards their distal extremity, the area without muscular fibres which is usually to be observed in the genus *Clio*.[1]

As regards the systematic relations of the genera and species, the family Limacinidæ is still but imperfectly understood. This is in part doubtless due to the small size of the animals which form the family. They have hitherto been but rarely studied, and even in special works on Pteropods are often slurred over, as for instance in the memoirs of Quoy and Gaimard and of Rang. In the same way Troschel and Gegenbaur in their studies on the Pteropods of the Mediterranean have not discussed a single member of this family, and we may also note that Pfeffer, who has published an important description of the Thecosomata in the Hamburg Museum, has quite overlooked the Limacinidæ.

The investigation of the numerous specimens of this family which were collected on the Challenger Expedition has enabled me to make an almost complete study of the entire family. The results of my investigation I therefore proceed to submit.

If one considers the living species alone, one finds in the literature of the subject that there are no less than thirty-six different specific names applied to forms referred to this family. In this number I do not include, be it understood, the manuscript species, or those which have been simply recorded without description or figure—*Limacina carinata*, Jeffreys,[2] *Spirialis diversa*, Monterosato,[3] *Spirialis contorta*, Monterosato.[4] These I evidently could not take into account.

Since the work of Souleyet,[5] Boas is the only naturalist who has attempted to make a synthetic study of this group.[6]

From the researches of these authors it may be concluded that there are now seven species adequately enough known by their shell, operculum, and anatomy to leave no doubt as their systematic position. These species are the following, and in citing them I shall retain the original generic titles, omitting for the present the discussion of their proper generic distribution.

[1] Boas considers this space as corresponding to the hollow which separates the small tentacle-like lobe of the fin of some species of *Limacina* and *Clio* of the subgenus *Creseis*, from the margin of this fin (Spolia atlantica, p. 182, pl. v. figs. 70–79).

[2] The French Deep-Sea Exploration in the Bay of Biscay, Rep. Brit. Assoc., 1880, p. 387.

[3] Nuova rivista delle conchiglie Mediterranee, p. 50.

[4] *Ibid.*, p. 50.

[5] Histoire naturelle des Mollusques Ptéropodes.

[6] Spolia atlantica, pp. 38–50.

1. *Atlanta inflata*, d'Orbigny.
2. *Atlanta lesueurii*, d'Orbigny.
3. *Clio helicina*, Phipps.
4. *Spirialis australis*, Eydoux and Souleyet.
5. *Limacina balea*, Möller.
6. *Atlanta trochiformis*, d'Orbigny.
7. *Atlanta bulimoides*, d'Orbigny.

The considerable number (twenty-nine) of other forms described (often very imperfectly, and without examination of the animals) includes the following forms. I should rather say did include the following when I undertook this Report, for as the result of the investigation about to be recounted, certain changes in the grouping become necessary. Thus one species in Group III. must be referred to Group I., while two species of Group II. must be placed at the end of the seven species chronicled above.

I. One, which I cannot regard as a Pteropod: *Limacina turritelloides*, Boas.

II. Four, which appear to me to belong quite clearly to the Thecosomatous Limacinidæ:—

Embolus triacanthus, Fischer.
Limacina antarctica, Woodward.
Limacina helicoides, Jeffreys.
Atlanta reticulata, d'Orbigny.

III. Four, which seem to me much less certain, but in regard to which the reports of those who have studied them are not sufficient to admit of a positive conclusion as in the case of the two preceding groups. Until further information is forthcoming they must be regarded as doubtful:—

Limacina (?) cucullata, Gould.
Agadina gouldi, A. Adams.
Agadina stimpsoni, A. Adams.
Atlanta rotunda, d'Orbigny.

IV. Finally, all the other specific titles are synonyms either of some of the seven well-known species, or of the four included in the second group:—

Argonauta artica, Fabricius, . .
Limacina helicialis, Lamarck, . .
Spiratella limacina, de Blainville, .
Limacina pacifica, Dall, . .
} = *Clio helicina*, Phipps.

Peracle flemingii, Forbes, . .
Limacina balea, Möller, . .
Scæa stenogyra, Philippi, . .
Spirialis gouldii, Stimpson, . .
Spirialis jeffreysii, Forbes and Hanley, .
Spirialis macandrei, Forbes and Hanley,
Heterofusus alexandri, Verrill, .
} = *Heterofusus retroversus*, Fleming.

Limacina naticoides, Rang, . . = *Atlanta trochiformis*, d'Orbigny.

Atlanta rangii, d'Orbigny (?), . . } =*Atlanta lesueurii*, d'Orbigny.
Spirialis ventricosa, Eydoux and Souleyet, }

Spirialis rostralis, Eydoux and Souleyet, }
Protomedea elata, O. G. Costa, . } =*Atlanta inflata*, d'Orbigny.
Limacina scaphoidea, Gould, . . }

Peracle physoides, Forbes, . . }
Spirialis clathrata, Eydoux and Souleyet, } =*Atlanta reticulata*, d'Orbigny.
Spirialis recurvirostra, A. Costa, . }

To these known species I can also add a new form included in the Challenger collection, which may without hesitation be referred to Group II. of undoubted Limacinidæ. Another form, which cannot be identified with any of those hitherto known, seemed at first to be referable to Group III. above, but subsequent examination has shown that it must rather be placed in Group I. along with another species of the same nature.

How are these different species to be distributed throughout the family? Or, in other words, how many distinct genera can be distinguished.

The question is indeed a most difficult one, and there are almost as many opinions on the subject as there are investigators of the group. Very few of the expressed opinions, however, claim much serious attention, for there has hardly been any previous attempt to make a systematic synthesis of the family Limacinidæ.

If we turn to the table of genera (p. 8) we see that twelve generic titles have been invented for living Thecosomata with spiral twisting, that is to say, just the same number of genera as there are certainly admissible species. I append the titles in chronological order :—

1. *Limacina*, Cuvier, 1817.
2. *Heterofusus*, Fleming, 1823.
3. *Spiratella*, de Blainville, 1824.
4. *Heliconoides*, d'Orbigny, 1836.
5. *Spirialis*, Eydoux and Souleyet, 1840.
6. *Helicophora*, Gray, 1842.
7. *Peracle*, Forbes, 1844.
8. *Scæa*, Philippi, 1844.
9. *Campylonaus*, Gray, 1847.
10. *Euromus*, A. and H. Adams, 1858.
11. *Protomedea*, O. G. Costa, 1861.
12. *Embolus*, Jeffreys, 1869.

What increases the confusion resulting from this superfluity of generic nomenclature in a group with so few forms, is the fact that several of these names have been used in different ways by different authors. Hence a complex and contradictory set of synonyms.

Gray (1850),[1] Gould (1852),[2] and Boas (1886)[3] have tried to simplify the matter by uniting all the known species in a single genus with the oldest title, *Limacina*, Cuvier. But it must be noted that Gould knew but few species of Limacinidæ, and that for one form which he regarded as new he even thought that it might be well to create a new genus. Jeffreys[4] also unites in a single genus, *Limacina*, all the species which he discusses except *Atlanta inflata*, d'Orbigny, for which he establishes a genus *Embolus*, although a certain species which he calls *Limacina* differs more from the typical *Limacina* than does *Atlanta inflata*. And besides, as we shall afterwards see, that solution of the difficulty which seeks to unite in a single genus all the living Limacinidæ is not in conformity with the differences of organisation exhibited by the various types.

There is only one way of restoring order to the confused nomenclature, and that is to find for each generic title the connotation given to it by its inventor, and the type to which it was originally applied. In this way alone can one recognise with any certainty what are the synonymous titles, and eliminate the more recent tautologies.

Let us then see what titles ought to be expelled from the nomenclature.

I. It is necessary first of all to abstract the genus *Agadina*, Gould, which, as we shall immediately see, has been too inadequately and imperfectly diagnosed to admit of any accurate conception being framed in regard to the organisms to which it ought to be applied.

II. The genus *Spiratella* was founded in 1824 by de Blainville for *Clio helicina*, Phipps. But for the same species the genus *Limacina* was erected by Cuvier in 1817. The name *Spiratella* need not therefore be retained.

III. The genera *Heliconoides*, d'Orbigny (1836), *Spirialis*, Eydoux and Souleyet (1840), and *Helicophora*, Gray (1842), are all based upon the same series of small forms, but without reference to any particular type. This series includes among its species three forms of shell, and to this it is due that the above titles have been used with different connotations by different authors (the brothers Adams, Bronn, Carus, Fol, Sars, &c.).

These forms of shell are—(1) a more or less elevated spiral with a simple lip; (2) a depressed spiral with a rostrated lip; and (3) with a very large aperture and a columella prolonged into the rostrum; and they have all received different names. The adoption of these new names evidently involves the abandonment of the titles noted above in the original sense of their authors. The new names corresponding to the three forms of shell are as follows:—

[1] Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda.

[2] The Mollusca and Shells of the U.S. Exploring Expedition.

[3] Spolia atlantica.

[4] New and peculiar Mollusca, &c., procured in the "Valorous" Expedition, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xix. p. 337.

1. *Heterofusus*, Fleming (1823), and *Scæa*, Philippi (1844); the former based on *Heterofusus retroversus*, Fleming, the latter on *Scæa stenogyra*, Philippi. But as these two species are identical, the two generic titles are absolutely synonymous, and the more recent ought to disappear.

2. *Protomedea*, O. G. Costa (1861), and *Embolus*, Jeffreys (1859); the former based on *Protomedea elata*, O. G. Costa, and the latter on *Atlanta inflata*, d'Orbigny. But as the two species are synonymous, the two generic titles are equally so; and since the name *Protomedea* was applied in 1834, by de Blainville, to a Cœlenterate, it ought to disappear.

3. *Peracle*, Forbes (1844), *Campylonaus*, Gray (1847), and *Euromus*, A. and H. Adams (1858); the two last based on *Atlanta reticulata*, d'Orbigny (= *Spirialis clathrata*, Eydoux and Souleyet), and the first on *Peracle physoides*, Forbes. But as these two specific types are now recognised to be identical, the three generic titles are obviously so too, and the two more recent ought to be disused.

Having reached this stage of our critical review, we see that the maximum number of generic titles which can be adopted for the Limacinidæ does not exceed those four—*Limacina*, *Heterofusus*, *Embolus*, and *Peracle*—since we may abstract *Heliconoides* (= *Spirialis* = *Helicophora*), this genus being succeeded by the three generic titles referring to the three forms of shell which it includes.

But are *Heterofusus* and *Embolus* really distinct, with this simple difference, that in the second the spire is depressed and the lip rostrate? This can hardly be, for in almost all the genera of Gastropods there are species with short and others with elongated spirals, and the same is true of the rostrate lip. Thus in a group adjacent to the Limacinidæ, the important genus *Clio* (= *Cleodora*) exhibits nearly related species, some with a rostrum on the dorsal surface and others without. Nevertheless these forms are much too closely allied to be generically separated, and ought not the same to apply to *Heterofusus* and *Embolus*? Both exhibit in fact an umbilicate shell, with whorls increasing somewhat gently, and a semilunar operculum, with a right-handed spiral of few turns; nor do the animals exhibit any difference in their structure.

But besides having these characters in common, they share them with *Limacina*, from which they do not differ in any character sufficient to establish a generic distinction, although, as I have already noted, the reverse has been maintained by Gray, Gould, Boas, and to a certain extent by Jeffreys. It must be remarked on the other hand that Souleyet, who created the genus *Spirialis* (including *Heterofusus* and *Embolus*), recognised that it ought to be united with *Limacina* if there were an operculum in the latter.[1] But it is now sufficiently demonstrated that in *Limacina* an operculum does exist.

It is true that Sars maintains the generic distinction of *Limacina* and *Spirialis* (in

[1] Voyage de la Bonite, Zoologie, t. ii. p. 211.

the restricted sense of *Heterofusus*), principally on the ground of the transverse striæ (at right angles to the axis), which are found in *Limacina helicina*. But this character cannot be regarded as of the value of a generic distinction. If we turn for instance to a group but slightly removed from the Limacinidæ, the species of *Clio* of the subgenus *Creseis*, we see that *Clio chierchiæ*, Boas, also possesses these transverse striæ which are wholly absent in the other three species of the same subgenus. Yet one would not on that account dream of establishing a generic distinction on that simple fact, and *a fortiori* one cannot separate *Limacina* (*s. str.*) from "*Spirialis*."

As to the genus *Peraclis*, Forbes, it is so distinct that it must be retained, although d'Orbigny has referred its typical species to *Heliconoides*, Souleyet and A. Costa to *Spirialis*, and Gray, Jeffreys, and Boas to *Limacina*.

Peraclis differs indeed from the genus *Limacina* (as this has been defined above) in having a shell which is not umbilicate, has a few whorls ascending very rapidly, a larger aperture, a columella prolonged into a rostrum twisted into a spiral, and, further, in possessing a subcircular operculum, with a multispiral, left-handed coil. To this operculum neither d'Orbigny, Souleyet, nor Boas have attached the degree of importance demanded by its peculiar structure. But even if we do not take account of these differences, the structure of certain portions of the animal of *Peraclis* separates it markedly from all other Limacinidæ, as we shall afterward see, and necessitates the formation of a distinct group, opposed to all the rest of the family.

From the foregoing it results that there are among the living Limacinidæ only two different genera, *Limacina* and *Peraclis*, which may be readily distinguished by turning to the synoptic table of genera (p. 8).

Limacina,[1] Cuvier.

1817. *Limacina*, Cuvier, Le Règne animal, t. ii. p. 380.
1823. *Heterofusus*, Fleming, On a reversed species of Fusus, Mem. Wern. Soc., p. 498.
1824. *Spiratella*, de Blainville, Mollusques, Dict. d. Sci. Nat., t. xxxii. p. 284, iv. p.
1836. *Heliconoides*, d'Orbigny (*pars*), Voyage dans l'Amérique méridionale, t. v. p. 174.
1840. *Spirialis*, Eydoux et Souleyet (*pars*), Description sommaire de plusieurs Ptéropodes nouveaux ou imparfaitement connus, Rev. Zool., t. iii. p. 235.
1842. *Helicophora*, Gray, Synopsis of the contents of the British Museum, p. 59.
1844. *Scæa*, Philippi, Fauna Molluscorum utriusque Siciliæ, p. 164.
1861. *Protomedea*, G. O. Costa (*pars*), Microdoride Mediterranea, p. 73.
1869. *Embolus*, Jeffreys, British Conchology, vol. v. p. 114.

Shell umbilicate, with turns gradually increasing; with a fairly large aperture; and with a columella not prolonged into a rostrum; surface smooth or striated. The height of the spire, the form of the surface and that of the aperture, and the size of the

[1] Diminutive of *Limax*.

umbilicus vary according to the species. *Operculum* semilunar, with a right-handed spiral of a few whorls.

Animal with an indistinctly defined head, which is only marked externally (1) by the lips on the border of the mouth and (2) by the tentacles.

1. *Lips:* two dorso-ventral folds on the cephalic surface of the fins, united dorsally, diverging ventrally, where they are continued by a fold of the cephalic surface of the fins, and extend laterally to the edge of the fins. They thus enclose a ciliated area which plays an important part in alimentation.[1] The mouth, split dorso-ventrally, is situated between these lips, in the angle formed by their union.

2. *Tentacles*, asymmetrical, the left always less developed and further back than the right. The latter is very long and retractile into a sheath. The tentacles thus exhibit absolutely the same form as those of the Cavoliniidæ. Souleyet[2] noted that in *Limacina helicina* the right tentacle *seemed* to be situated in a sheath, and[3] that in his "*Spirialis*" the minuteness of the organs did not permit him to observe whether this was again true. I have been able to convince myself that this sheath exists, not only in *Limacina helicina*, but in all the small species in which I have been able to study the animal, viz., *Limacina inflata*, *Limacina lesueuri*, *Limacina australis*, *Limacina trochiformis*.

Fins elongated, enlarged, truncated at their free end. In certain species—*Limacina helicina* (where the structure has been noted by P. J. van Beneden under the name of tentacles), *Limacina antarctica* and *Limacina australis* (where it was equally distinct)—the fins exhibit, towards the middle of their dorsal margin, a small narrow projecting lobe of a special structure. A similar structure exists in *Clio* in the subgenus *Creseis*. I have assured myself that in *Limacina inflata*, *Limacina lesueuri*, and *Limacina trochiformis* this small lobe is not present, and Boas vouches for its absence in *Limacina bulimoides*. In the other species the animal has not yet been examined.

I cannot attach any great systematic importance to the presence or absence of this minute lobe, or regard it as furnishing basis for generic or subgeneric distinction, for otherwise the entire organisation is so absolutely analogous in all the species of *Limacina*, and the lobe is present in *Limacina australis*, and absent in *Limacina retroversa*, species so closely allied that some authorities have doubted whether they were really distinct.

On turning to the table of species of Limacinidæ, it will be seen that there are only ten species which belong to the genus *Limacina* properly so called. Of these, seven are well known by their shell, their animal, and their operculum, while the other three are sufficiently well known to enable one to judge with some certainty in regard to their systematic position.

[1] See Boas, Spolia atlantica, p. 191.—An identical disposition is found in the Cavoliniidæ.

[2] Histoire naturelle des Mollusques Ptéropodes, p. 60.

[3] Voyage de la Bonite, Zoologie, t. ii. p. 209.

These ten species may be thus distinguished :—

KEY TO THE SPECIES.

I. Shell with a toothed lip.
  1. A single tooth on the lip, ... *Limacina inflata.*
  2. Three teeth on the lip, ... *Limacina triacantha.*

II. Shell without teeth on the lip.
  1. Spire very short.
    A. Shell with transverse striæ (at right angles to the axis).
      a. Mouth higher than broad, ... *Limacina helicina.*
      b. Mouth broader than high, ... *Limacina antarctica.*
    B. Shell without transverse striæ.
      a. Whorls hardly separated by a suture, . . . *Limacina helicoides.*
      b. Whorls separated by a deep suture, ... *Limacina lesueuri.*
  2. Spire high.
    A. Mouth quadrangular, columella arched to the right.
      a. Umbilicus widely open, ... *Limacina australis.*
      b. Umbilicus constricted, ... *Limacina retroversa.*
    B. Mouth oval, columella arched to the left.
      a. Umbilicus constricted, spire somewhat short, . . . *Limacina trochiformis.*
      b. Umbilicus very narrow, spire elongated, . . . *Limacina bulimoides.*

*[1]1. *Limacina inflata* (d'Orbigny).

1836. *Atlanta inflata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 174, pl. xii. figs. 16–19.
1840. *Spirialis rostralis*, Eydoux et Souleyet, Description sommaire de plusieurs Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 236.
1850. *Limacina inflata*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 31.
1852. *Limacina scaphoidea*, Gould, The Mollusca and Shells of the U.S. Exploring Expedition, p. 485, pl. li. fig. 602.
1861. *Protomedea elata*, O. G. Costa, Microdoride mediterranea, p. 74, pl. xi. fig. 5.
1870. *Embolus rostralis*, Jeffreys, Mediterranean Mollusca, Ann. and Mag. Nat. Hist., ser. 4, vol. vi. p. 86.
1882. *Protomedea rostralis*, Fischer, Sur la faune Malacologique abyssale de la Méditerranée, Comptes rendus, t. 94, p. 120.

Shell, animal, and operculum : for description and figures see Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 216, pl. xiii. figs. 1–10.

Habitat.—This *Limacina* is distributed in all the warm seas. It has been recorded from the following localities :—

Atlantic Ocean, from 42° N. to 40° S.; Mediterranean, frequently collected at Naples, where I have often observed it; found also, as represented by empty shells, in a large number of deep dredgings in the Mediterranean, *e.g.*, off Crete (Jeffreys);[2] Ægean Sea (Jeffreys);[3] and on different parts of the Mediterranean coast (Sicily, Piedmont, &c.).

[1] The species collected by the Challenger are marked by an asterisk.
[2] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xi. p. 401.
[3] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. vi. p. 86.

Indian Ocean; to the south-east of Arabia ("Vettor Pisani" Expedition, March 8, 1883); Gulf of Bengal and Ceylon (Kiel Museum); St. Paul and Amsterdam Islands (38° 42′ S. lat., 77° 34′ E.) (Professor Vélain, under the MS. title *Spirialis appendiculatus*).

Pacific Ocean; China Sea ("Galathea" Expedition); Corea Strait (Jeffreys);[1] Honolulu in the Philippines ("Vettor Pisani," August 28, 1884); North-West Pacific to 48° N. ("Galathea"); East Pacific, Panama, &c. ("Vettor Pisani," March 7, 1884); South-East Pacific to 40° S. (Knocker).[2]

Challenger Specimens.—I. Living specimens.

Station 142, December 18, 1873; Cape of Good Hope to 46° S.; lat. 35° 4′ S., long. 18° 37′ E.

Between Stations 162 and 163, April 3, 1874; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 201, October 26, 1874; Amboina to Samboangan; lat. 7° 3′ N., long. 121° 48′ E.

Station 216A, February 16, 1875; Samboangan to New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

Between Stations 264 and 265, August 24, 1875; Sandwich Islands to Tahiti; lat. 13° 15′ N., long. 152° 2′ W.

Station 337, March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ S., long. 13° 36′ W.

On April 26, 1876; off St. Vincent (Cape Verde Islands); lat. 16° 49′ N., long. 25° 14′ W.

II. Deposit shells.

Station VIII., February 12, 1873; off Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Station 3, February 18, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1525 fathoms; bottom, hard ground.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 32B, April 3, 1873; St. Thomas to Bermuda; lat. 32° 10′ N., long. 64° 52′ W.; depth, 950 fathoms; bottom, coral mud.

[1] Notice of some Shells dredged by Captain St. John, R.N., in Corea Strait, *Journ. Linn. Soc. Lond.* (Zool.), vol. xiv. p. 423, 1878.

[2] On Pelagic Shells collected during a Voyage from Vancouver Island to this Country, *Proc. Zool. Soc. Lond.*, p. 616, 1868.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 75, July 2, 1873; off Fayal (Azores); lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

Station 76, July 3, 1873; off the Azores; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island; lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 174, August 3, 1874; off Kandavu Island; lat. 19° 6′ 0″ S., long. 178° 14′ 20″ E.; depth, 140 fathoms; bottom, coral mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Station 335, March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom, Pteropod ooze.

Observations.—I regard the specimens brought by Mr. Ch. Vélain from the Islands of St. Paul and Amsterdam (French Transit of Venus Expedition, 1874) as identical with the above species. They were described under the MS. title *Spirialis appendiculatus*, and are characterised by the fact that "the last whorl exhibits on its dorsal region a narrow, flattened surface, corresponding to the rostrum of the free margin" (M. Vélain's MS.).

In almost cosmopolitan animals like *Limacina inflata* and other Thecosomata, it must be noted that there is a greater expression of variability than in species of less extensive distribution. For this reason the creation of new species must not be accepted without full consideration. Many of the so-called "species" are at most local varieties, and in the case just noticed, the difference emphasised by M. Vélain is of minimum importance, and may be observed on specimens from other sources.

It must have been by a slip of the pen that Jeffreys[1] has associated this form with "*Spirialis macandrei*," Forbes and Hanley (=*Limacina retroversa*). With some

[1] On the Marine Testacea of the Piedmontese Coast, *Ann. and Mag. Nat. Hist.*, ser. 2, vol. xvii. p. 180.

hesitation the same author[1] also unites *Bellerophon minuta*, Forbes,[2] with the present species. But the perfect bilateral symmetry of this very minute shell makes it more probable that it is only a young *Oxygyrus keraudreni* (Heteropod).

*2. *Limacina triacantha* (Fischer) (Pl. I. figs. 1, 2).

1882. *Embolus triacanthus*, Fischer, Diagnoses d'espèces nouvelles de Mollusques recueillis dans le cours de l'Expédition scientifique de l'aviso le Travailleur (1880, 1881), Journ. de Conchyl., t. xxx. p. 49.

Characters and Description.—Smooth globular shell, flattened above. Spire very short. Three whorls, expanded and overlapping, lying almost in the same plane as in the preceding species. Suture well marked. Mouth large and widened; lip with three teeth, one above almost on the suture, one inferior, and the third on the lower half on the face of the longer portion of the curve. The two last teeth are the largest, and with each tooth there corresponds a longitudinal rib, somewhat narrow and projecting, parallel to the axis of the shell. The two superior ribs do not extend over the whole of the last coil. Straight columella. Narrow umbilicus. Colour whitish, the three ribs brown.

Dimensions.—The maximum diameter and height of the shell are almost equal, and measure $4\frac{1}{2}$ mm. in the larger specimens.

The animal and the operculum are unknown.

Habitat.—Atlantic Ocean, to the south of Spain, at a depth of 1205 metres.

Challenger Specimens.—Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 76, July 3, 1873; off the Azores; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze.

Station 85, July 19, 1873; off Palma Island; lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Observations.—It is quite likely that *Embolus elatus*, Seguenza[3] (not *Protomedea elata*, Costa), from the Sicilian Pliocene is identical with the above species. The diagnosis,[4]

[1] On Mediterranean Mollusca, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. vi. p. 86.

[2] Report on the Mollusca and Radiata of the Ægean Sea, &c., Rep. Brit. Assoc., p. 186, 1843.

[3] Studii stratigraphici sulla formazione pliocenica, *Bull. del R. Comit. geol.*, fasc. 5, 6, p. 148, 1875.

[4] Studii paleontologici sulla fauna malacologica dei sedimenti pliocenici depositati a grandi profondita, p. 31.

unaccompanied by any figure, does not, however, admit of certain decision on this point.

The fact that this species has only been found in the deep-sea deposits, and that over a wide area, but has never been collected alive at the surface, raises the question whether it be not really extinct. The remains of fossil Elasmobranchs and Cetaceans found at the bottom of modern seas make this hypothesis more plausible.

Although neither the animal nor the operculum of *Limacina triacantha* have been as yet observed, there cannot be any doubt that the form in question is a Pteropod. It is indeed difficult to decide, in the absence of the animal, that an empty shell, twisted in a left-handed spiral, really belongs to the Thecosomatous Pteropods and the group Limacinidæ, and not to some Gastropodous group, but in the present case there can hardly be any hesitation, as is shown by the following characters :—

1. The constancy of the left-handed spiral of the shell, which is observed in all the specimens, shows that we have not to deal with an abnormal left-handed example of a right-handed Gastropod.

2. The great breadth of the transverse diameter is not what is normally found in left-handed Gastropods, which usually exhibit an elongated spiral.

3. The thinness of the test is also suggestive.

4. The predominance of Thecosomatous Pteropod shells in the sediments from which the present species was dredged is in itself an argument.

5. The numerous resemblances between the species and *Limacina inflata* suggest a close affinity.

3. *Limacina helicina* (Phipps).

1774. *Clio helicina*, Phipps, A voyage towards the North Pole, p. 195.
1774. *Clione helicina*, Pallas, Spicilegia zoologica, fasc. x. p. 38.
1780. *Argonauta arctica*, Fabricius, Fauna grœnlandica, p. 386.
1819. *Limacina helicialis*, Lamarck, Histoire naturelle des animaux sans vertèbres, t. vi. p. 291.
1824. *Spiratella limacina*, de Blainville, Dict. d. Sci. Nat., t. xxxii. p. 284.
1832. *Spiratella arctica*, Deshayes, Encyclopédie méthodique, Vers, t. iii. p. 138.
1841. *Limacina arctica*, Möller, Bemaerkninger til slaegten Limacina, Krøyer, Nat. Hist. Tidsskr., 1 Raekke, Bd. iii. p. 488.
1852. *Limacina helicina*, Souleyet, Histoire naturelle des Mollusques Ptéropodes, p. 61.
1872. *Limacina pacifica*, Dall, Description of sixty new forms of Molluscs from the West Coasts of North America and the North Pacific Ocean, Amer. Journ. of Conch., vol. vii. p. 138.

For description and figures, I refer to Sars, Mollusca regionis arcticæ Norvegiæ (1878), p. 328, pl. 29, fig. 1.

Habitat.—The area of distribution is similar to that of *Clione limacina*.—Davis Strait; Hudson Strait; Greenland; Iceland; Jan Meyen Island; Southern Norway; White Sea (Wagner); Spitzbergen; Nova Zembla; Sea of Okhotsk; North Pacific: Monterey,

South Alaska (35° 50′ N.) (Dall); Arctic Ocean: Point Barrow (surface temperature, 40°·2 F. to 42°) (Dall);[1] Aleutian Islands (Krause).

Observations.—I. As in all other species of *Limacina* there is an operculum, but it is caducous in the older specimens. I emphasise the presence of this operculum, because recent works, such for instance as Claus's Textbook, still characterise *Limacina* (*s. str.* type *Limacina helicina*) by the absence of this structure. In 1878 Sars definitely demonstrated its existence.

The caducous character of the structure is no isolated fact, for we know not only genera (*Pleurotoma, Voluta,* &c.) in which certain species have, and others have not, an operculum, but also species in which it is sometimes present, sometimes absent, according to the individual (*Volutharpa ampullacea,* Middendorf).

II. I consider *Limacina pacifica,* Dall, as identical with *Limacina helicina.* In fact, according to Dall and Krause, this form differs from *Limacina helicina* only in having more whorls on its spire, and in the absence of an operculum. But these are precisely the characters of the adult *Limacina helicina,* with which *Limacina pacifica* is therefore identical.

*4. *Limacina antarctica,* Woodward (Pl. I. figs. 3, 4).

1856. *Limacina antarctica,* Woodward, A Manual of the Mollusca, p. 207, *nomen tantum,* pl. xiv. fig. 4.

Characters and Description.—Subdiscoidal, flattened shell, with a spire very slightly elevated, rather depressed. Six whorls, ribbed superiorly like those of *Limacina helicina,* and, in spite of the slight elevation of the spire, quite distinct, and separated by a well-defined suture. The whorls are rounded externally and inferiorly, the last is much expanded. Large mouth, broader than high, rounded off externally, and not prolonged into an angle. Arched columella. Large umbilicus, not surrounded by a keel as in *Limacina helicina.* Transverse striæ, perpendicular to the axis, arched, regular, and equidistant.

Dimensions.—Maximum diameter 4 to 5 mm.; the height equal to about half the diameter.

Operculum unknown, probably like that of *Limacina helicina,* and caducous in the adult specimens, which alone have been examined.

Animal very like that of the preceding species. The anterior (dorsal) marginal lobe of the fin is very small, though perhaps somewhat contracted in the only specimen in which I was able to examine it. The posterior lobe of the foot is markedly hollowed out on its free margin. Tentacles like those of *Limacina helicina;* the left rudimentary, the right very long, situated in a sheath, and further forward than the left.

[1] Report on the international North Polar Expedition to Point Barrow, 1885, Report on the Mollusks, p.

Habitat.—Antarctic Ocean, where it seems to replace *Limacina helicina*, between 63° and 64° S. lat. (Ross, under the title "*Argonauta arctica*").

Challenger Specimen.—Living. Station 153, February 14, 1874; in vicinity of Antarctic ice; lat. 65° 42′ S., long. 79° 49′ E.

Observation.—The single specimen in the Challenger collection had its shell quite broken into small fragments. The description of the shell has been based on the unpublished figures of Hooker (1840). Two of these are reproduced on Pl. I. figs. 3, 4, entirely on the responsibility of Hooker.

*5. *Limacina helicoides*, Jeffreys (Pl. I. fig. 5).

1877. *Limacina helicoides*, Jeffreys, New and peculiar Mollusca of the Family Eulimidæ and other Families of Gastropoda as well as of the Pteropoda, procured on the "Valorous" Expedition, Ann. and Mag. Nat. Hist., ser. 4, vol. xix. p. 338.

Characters and Description.—Shell smooth and shining, with a depressed, but not flattened spire, of three or four whorls, rounded but not expanded, with a continuous surface, that is to say, only separated by a slightly marked, though distinct suture. Aperture somewhat elongated, and angular anteriorly. Columella twisted in a spiral.

Colour.—Horny brown.

Dimensions.—Height and transverse diameter almost equal, measuring 3·75 mm.

Operculum and animal unknown. This species is perhaps in the same position as *Limacina triacantha*.

Habitat.—Atlantic Ocean to the north of the Equator, always at the bottom, with the shell empty:—"Valorous" Expedition, Station 12; lat. 56° 11′ N., long. 37° 41′ W.; at a depth of 1450 fathoms. "Porcupine" Expedition (1869), west of Ireland, Station 28; lat. 56° 44′ N., long. 12° 52′ W.; at a depth of 1215 fathoms. "Porcupine" Expedition (1870), Station 17, Bay of Vigo (not Bay of Biscay as Jeffreys says[1]); lat. 39° 42′ N., long. 9° 43′ W.; at a depth of 750 to 1095 fathoms. "Travailleur" Expedition (1800), Bay of Biscay.[2]

Challenger Specimen.—Deposit shell.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

[1] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xix. p. 338.

[2] Jeffreys, The French Deep-Sea Exploration in the Bay of Biscay, Rep. Brit. Assoc., 1880, p. 387.

*6. *Limacina lesueuri* (d'Orbigny).

1836. *Atlanta lesueurii*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 177, pl. xx. figs. 12–15.

1836. *Atlanta rangii*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 176, pl. xii. figs. 25–28.

1840. *Spirialis ventricosa*, Eydoux et Souleyet, Description sommaire de plusieurs Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 236.

1850. *Limacina ventricosa*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 32.

1886. *Limacina lesueurii*, Boas, Spolia atlantica, K. dansk. Vidensk. Selsk. Skriv., 6 Raekke, Bd. iv. p. 46, pl. iii. figs. 33, 34.

For description and figures I refer to Souleyet.[1] I shall restrict myself to noting that in the form of its aperture, columella, and umbilicus, this species is closely allied to *Limacina australis* and *Limacina retroversa*, with which it forms a very natural sub-group. Though the spire is depressed, it preserves none the less the distinctness of its whorls, which are separated by a very well defined suture.

Animal without a small lobe on the anterior dorsal margin of the fin.

Habitat.—The following localities have been recorded:—Atlantic Ocean, from 36° S. (d'Orbigny) to the Bay of Biscay (Pfeffer).[2] Indian Ocean, Islands of St. Paul and Amsterdam (Vélain, under MS. title *Limacina crossei*). West Pacific Ocean, 30° N. lat., 170° W. long. ("Galathea" Expedition), towards Batavia (Boas);[3] East Pacific Ocean (d'Orbigny), to 42° S. lat. (Knocker).

Challenger Specimens.—I. Living specimens.

Between Stations 162 and 163, April 3, 1874; on the route from Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

Between Stations 246 and 247, July 4, 1875; Yokohama to Sandwich Islands; lat. 36° 42′ N., long. 171° 46′ E.

Between Stations 264 and 265, August 24, 1875; Sandwich Islands to Tahiti; lat. 13° 15′ N., long. 152° 2′ W.

Station 337, March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ S., long. 13° 36′ W.

On April 26, 1876; off St. Vincent (Cape Verde); lat. 16° 49′ N., long. 25° 14′ W.

On May 7, 1876; off the Azores; lat. 34° 22′ N., long. 34° 23′ W.

[1] Voyage de la Bonite, Zoologie, t. ii. p. 216, pl. xiii. figs. 11–16.

[2] Uebersicht der auf S.M. Schiff Gazelle und von Dr. Jagor gesammelten Pteropoden, *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, p. 245, 1879.

[3] Spolia atlantica, p. 47.

II. Deposit shells.

Station VIII., February 12, 1873; off Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Station 3, February 18, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1525 fathoms; bottom, hard ground.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 85, July 19, 1873; off Palma Island; lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Observations.—I. It is very probable that *Atlanta rangii*, d'Orbigny, which Souleyet[1] has hesitatingly referred to his *Spirialis ventricosa*, is identical with the above species. But since the somewhat imperfect description and figure of d'Orbigny exclude the possibility of absolute certainty, it is better to adopt, as we have done, the specific title *lesueuri*, although this species does not occur in d'Orbigny's work till several pages after *Atlanta rangii*.

II. *Atlanta rotunda* of the same authority,[2] which Souleyet[3] regards as a variety of his *Spirialis ventricosa*, appears to us very different indeed. In our opinion it is not even a Pteropod, as we shall explain further on in our appendix to the Limacinidæ.

*7. *Limacina australis* (Eydoux and Souleyet) (Pl. I. fig. 6).

1840. *Spirialis australis*, Eydoux et Souleyet, Description sommaire de quelques Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 237.

Characters and Description.—Smooth shell, with spire somewhat elevated, with a blunted or obtuse apex, with six or seven bulging whorls, separated by a very deep suture,

[1] Histoire naturelle des Mollusques Ptéropodes, p. 63.
[2] Voyage dans l'Amérique méridionale, t. v. p. 175, pl. xii. figs. 20–24.
[3] Histoire naturelle des Mollusques Ptéropodes, p. 63.

with the last whorl much expanded and convex, and projecting more in proportion than all the foregoing. Aperture quadrangular, somewhat angled in front; columella straight, reflected to the right; umbilicus broad.

Colour.—Milky.

Dimensions.—2 to 2·5 mm. in height, about 1·5 mm. in maximum diameter.

Operculum approximately oval, with an almost straight columellar margin, and with a spiral portion measuring barely two-fifths of the entire length.

The animal exhibits a small lobe on the dorsal margin of each fin.

Habitat.—Cape Horn (Souleyet).

From its discovery by Souleyet this species was not reobserved until the Challenger Expedition. Jeffreys[1] follows Vérany in noting the coast of Piedmont as a locality of *Spirialis australis*, and this has been repeated without question by various authors.[2] The statement is, however, entirely erroneous, and has in all probability reference to *Limacina trochiformis*.

The specimens collected by the Challenger show that this species has a somewhat wide distribution round the South Pole, where it occupies, along with *Limacina antarctica*, a position analogous to that of *Limacina retroversa* and *Limacina helicina* in the north.

Challenger Specimens.—Living.

Station 146, December 29, 1873; Marion Island to Crozets; lat. 46° 46′ S., long. 45° 31′ E.

Station 149, January 9, 1874; at Kerguelen Island; lat. 49° 8′ S., long. 70° 12′ E.

Station 150, February 2, 1874; Heard Island; lat. 52° 4′ S., long. 71° 22′ E.

Between Stations 154 and 155, February 21, 1874; in vicinity of Antarctic Ice; lat. 63° 30′ S., long. 89° 8′ E.

Observations.—Boas[3] has expressed hesitation in regard to the possible specific identity of *Limacina australis*, *Limacina retroversa*, and *Limacina trochiformis*. They are, however, as we shall see, three very distinct forms.

In the first place, as regards *Limacina trochiformis*, it belongs along with *Limacina bulimoides* to a special group of *Limacinæ* quite different from that to which *Limacina australis* and *Limacina retroversa* are to be referred. It is characterised by the presence of a shell with oval, rounded aperture, with the columellar margin reflected to the left, and with a very narrow umbilicus. In *Limacina bulimoides* and *Limacina trochiformis* also the animal is without any lobe on the fin. In *Limacina australis*, on the other hand, the opening of the shell is quadrangular, with the columellar margin reflected to the right, with a very broad umbilicus, and a tentacle-like lobe on the dorsal margin of the

[1] On the Marine Testacea of the Piedmontese Coast, *Ann. and Mag. Nat. Hist.*, ser. 2, vol. xvii. p. 180.

[2] For instance Weinkauff, Die Conchylien des Mittelmeeres, t. ii. p. 428.

[3] Spolia atlantica, p. 46.

fin. Furthermore, the spire is proportionally much shorter in *Limacina trochiformis*, and the operculum has a form differing from that of all the other species in the large extent of its spiral portion (three-sevenths) and in the convexity of its columellar margin.[1] In *Limacina australis*[2] the columellar margin of this operculum is almost rectilinear, and the spiral portion hardly attains to more than a third of the total length. *Limacina trochiformis* has certainly less affinity with *Limacina australis* than *Limacina lesueuri*, in spite of the depressed spiral of the latter.

As to *Limacina retroversa*, it is certainly more nearly allied to *Limacina australis* than *Limacina trochiformis*, but the characters which distinguish it from that form are quite distinct enough to be recognised as specific. Thus the umbilicus of *Limacina retroversa*, while quite distinct, is very narrow,[3] in contrast to that of *Limacina australis*, which as we have seen is very broad.[4] The spire is pointed in *Limacina retroversa*, but obtuse in *Limacina australis*, where the whorls are besides more convex, less numerous, and separated by a shallower suture. Even at first sight *Limacina australis* is distinguished from *Limacina retroversa* by the expansion of the last coil and by its projection beyond those in front. Finally, in *Limacina retroversa* the spiral portion of the operculum is much more reduced than that of *Limacina australis*.[5]

8. *Limacina retroversa* (Fleming).

1788. (?) *Turbo lunaris*, Gmelin, Systema naturæ, i. p. 3587.
1823. *Heterofusus retroversus*, Fleming, On a reversed species of Fusus, Mem. Wern. Nat. Hist. Soc., vol. iv. p. 498, pl. xv. fig. 2.
1841. *Limacina balea*, Møller, Bemaerkninger til slaegten Limacina, Krøyer, Nat. Hist. Tidsskr., 1 Række, Bd. iii. p. 489.
1844. *Peracle flemingii*, Forbes, in Thompson, Report on the Fauna of Ireland, Rep. Brit. Assoc., 1843, p. 249.
1844. *Scæa stenogyra*, Philippi, Fauna Molluscorum utriusque Siciliæ, p. 164, pl. xxv. fig. 20.
1846. *Spirialis stenogyra*, Lovén, Index Molluscorum litora Scandinaviæ occidentalia habitantium, Översigt k. Vetensk.-Akad. Förhandl., 1846, p. 4.
1849. *Spirialis flemingii* and *Spirialis macandrei*, Forbes and Hanley, History of the British Mollusca and their Shells, vol. ii. pp. 384, 385, pl. lvii. figs. 4, 5, 6, 7.
1849. (?) *Spirialis jeffreysii*, Forbes and Hanley, *Ibid.*, vol. ii. p. 386, pl. lvii. fig. 8.
1850. *Limacina retroversa*, Gray, Catalogue of the Mollusca in the collection of the British Museum, pt. 2, Pteropoda, p. 33.

[1] Souleyet, Voyage de la Bonite, Zoologie, Mollusques, pl. xiii. fig. 33.
[2] Souleyet, *Ibid.*, pl. xiii. fig. 24.
[3] Sars, Mollusca regionis arcticæ Norvegiæ, pl. 29, figs. 2*c*, 3*b*.
[4] Souleyet, Voyage de la Bonite, Zoologie, Mollusques, pl. xiii. fig. 23.
[5] Sars, Mollusca regionis arcticæ Norvegiæ, pl. 29, figs. 2*d*, 3*d*.

1851. *Spirialis gouldii*, Stimpson, Description of two new species of shells of Massachusetts, Proc. Boston Soc. Nat. Hist., vol. iv. p. 8; and Shells of New England, p. 27, pl. i. fig. 4.

1857. *Heterofusus balea*, Mørch, in Rink, Grønland geographisk, statistisk og naturhistorisk beskrevet, p. 86.

1872. *Heterofusus alexandri*, Verrill, Recent Additions to the Molluscan Fauna of New England, &c., Amer. Journ. Sci. and Arts, ser. 3, vol. iii. p. 284.

1878. *Spirialis balea* and *Spirialis retroversa*, Sars, Mollusca regionis arcticæ Norvegiæ, pp. 329, 330, pl. 29, figs. 2, 3.

For description and figures see Sars, *loc. cit.*

Habitat.—North Atlantic, on the coast of America, from 63° N. (Davis Strait) to 39° 53′ N. (Massachusetts Bay, Verrill); Iceland; coasts of Europe, from Lofoden Island to 50° N., though not yet recorded from Behring Straits.

All records which mention this species as having been found in more southerly localities, and notably in the Mediterranean, are erroneous, and ought to apply to *Limacina trochiformis*, with which *Limacina retroversa* has been confused by Jeffreys,[1] Weinkauff,[2] Costa,[3] and other conchologists. *Limacina retroversa* is no longer found in the Mediterranean, though it occurs in circa-Mediterranean Pliocene and Quaternary deposits ("*Scæa stenogyra*").

In the deep-sea deposits this species is found in the North Atlantic over an area extending somewhat further south, and it has thus been dredged in the Bay of Biscay by the French "Travailleur" Expedition (1880).[4]

Observations.—I. Some authorities (Jeffreys, Gould, Sars, Verrill, &c.) regard *Heterofusus retroversa* and *Limacina balea* as two distinct forms.

Sars supports this in his descriptions and figures. According to him, the two forms differ, apart from size which cannot be regarded as distinctive, especially in the fact that in *Limacina balea* the surface is longitudinally striated (parallel to the axis of the shell) and that its spire is proportionally longer.

To the first of these two points, it may be answered that in *Limacina retroversa* the surface also exhibits longitudinal striæ, less marked, it is true, but distinctly recognisable,[5] and that in *Scæa stenogyra*, Philippi,[6] which Sars identifies with *Limacina balea*, the surface is on the contrary "lævissima." This point of distinction does not, therefore, appear conclusive.

[1] British Conchology, vol. v. p. 116.

[2] Die Conchylien des Mittelmeeres, Bd. ii. p. 486.

[3] Pteropodi della fauna del Regno di Napoli, p. 19.

[4] Jeffreys, The French Deep-sea Exploration in the Bay of Biscay, Rep. Brit. Assoc., 1880, p. 387.

[5] Sars, Mollusca regionis arcticæ Norvegiæ, pl. 29, fig. 3*e*; Gould, Report on the Invertebrata of Massachusetts, ed. 2, pl. xxvii. figs. 345–348.

[6] Philippi, Fauna Molluscorum utriusque Siciliæ, pl. xxv. fig. 20.

As to the argument based on the relative height of the spire, the average proportion of height to maximum diameter is $\frac{40}{27}$ in *Limacina balea*, and $\frac{32}{27}$ in *Heterofusus retroversus*. But in *Spirialis gouldii*, Stimpson, identified by Sars with *Limacina balea*, and with very well marked transverse striation, the apparently very exact figure given by Stimpson[1] exhibits the above ratio as $\frac{31}{27}$, less, that is to say, than that of *Heterofusus retroversus*, while in *Scæa stenogyra*, with smooth surface, the ratio according to Philippi's figure is $\frac{37}{27}$.

It is thus seen that the relative height of the spire varies as well as the striation of the surface, and that the variations of these two features are independent. We are, therefore, led to conclude that *Limacina balea* and *Heterofusus retroversus* are not two specifically distinct forms, but belong to a single species which exhibits a certain number of varieties.

*9. *Limacina trochiformis* (d'Orbigny).

1836. *Atlanta trochiformis*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 177, pl. xii. figs. 29–31.

1840. *Spirialis trochiformis*, Eydoux et Souleyet, Description sommaire de quelques Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 237.

1850. *Limacina trochiformis*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 33.

1852. *Limacina naticoides*, Rang, Histoire naturelle des Mollusques Ptéropodes, pl. x. figs. 1, 2.

For description and figures see Souleyet.[2]

The umbilicus of the shell is very small in this species. The dorsal (anterior) margin of the fin does not exhibit any tentacle-like lobe.

Habitat.—Atlantic Ocean, from 41° N. to 28° S.; Mediterranean, Naples (where I have often observed it alive), Malta (David Bruce); the shell has been dredged at a great number of localities in the Mediterranean—Crete (Jeffreys), &c.; Indian Ocean, south-east of Arabia (Blanford); Pacific Ocean, China Sea (Gray), Malay Archipelago (Copenhagen Museum); Equatorial Pacific to 152° W.; South-east Pacific to 30° S. (d'Orbigny).

Challenger Specimens.—I. Living specimens.

Between Stations 162 and 163, April 3, 1874; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

[1] Shells of New England, pl. i. fig. 4.

[2] Voyage de la Bonite, Zoologie, t. ii. p. 223, pl. xiii. figs. 27–34.

Between Stations 264 and 265, August 24, 1875; Sandwich Islands to Tahiti; lat. 13° 15′ N., long. 152° 2′ W.

Station 337, March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ S., long. 13° 36′ W.

II. Deposit shells.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Observations.—I have already stated that Boas has expressed doubts as to the specific distinctness of *Limacina australis*, *Limacina retroversa*, and *Limacina trochiformis*, and I have shown that *Limacina australis* could not be identified with either of the other two species.

As concerns the latter, they have been deplorably confused by a great many authors, Jeffreys,[1] MacAndrew, Weinkauff,[2] A. Costa,[3] Monterosato, &c., who have attributed to *Limacina retroversa* a geographical distribution much more extensive than it really possesses, by crediting it with localities such as the Mediterranean, the Canaries, &c., which ought to refer to *Limacina trochiformis* alone. *Limacina trochiformis* differs however from *Limacina retroversa* (as also from *Limacina australis*, which belongs to same group), (1) in the oval form of the mouth, which is rounded anteriorly, and has the columellar margin recurved to the left, in contrast to *Limacina retroversa* where the mouth is quadrangular, pointed anteriorly, and with a rectilinear columellar margin; (2) in the constant shortness of the spiral in proportion to its last whorl, and (3) in the formation of the operculum, in which the spiral portion is large in *Limacina trochiformis*, and very small in *Limacina retroversa*.

*10. *Limacina bulimoides* (d'Orbigny).

1836. *Atlanta bulimoides*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 179, pl. xii. figs. 36–38.

1840. *Spirialis bulimoides*, Eydoux et Souleyet, Description sommaire de quelques Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 238.

1850. *Limacina bulimoides*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 34.

For description and figures see Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 224, pl. xiii. figs. 35–42.

[1] British Conchology, vol. v. p. 116.

[2] Die Conchylien des Mittelmeeres, t. ii. p. 428.

[3] Pteropodi della fauna del Regno di Napoli, p. 19.

The umbilicus of the shell is almost imperceptible. There is no tentacular lobe to the fin, as Boas has already noted.

Habitat.—Atlantic Ocean, from 40° S. to 30° N.; Indian Ocean, south-east of Arabia ("Vettor Pisani" Expedition, March 8, 1885); Pacific Ocean, Botany Bay (Angas);[1] China Sea and West Pacific to 40° N. ("Galathea" Expedition); Equatorial Pacific, South Pacific to 37° S. (Knocker); South-east Pacific (d'Orbigny).[2]

The empty shells of this species have been gathered from the deep-sea deposits in the Mediterranean, where the species is no longer found alive, in the Ægean Sea (Jeffreys), and in the Mediterranean dredgings of the "Travailleur" (Fischer);[3] in the North Atlantic (by the "Valorous" Expedition,[4] and by the first "Porcupine" Expedition, 1869).

Challenger Specimens.—I. Living specimens.

Between Stations 162 and 163, April 3, 1874; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 201, October 26, 1874; Amboina to Samboangan; lat. 7° 3′ N., long. 121° 48′ E.

Station 243, June 26, 1875; Yokohama to Sandwich Islands; lat. 35° 24′ N., long. 166° 35′ E.

Between Stations 247 and 248, July 4, 1875; Yokohama to Sandwich Islands; lat. 36° 42′ N., long. 179° 50′ W.

Station 337, March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ S., long. 13° 36′ W.

On April 26, 1876; off St. Vincent (Cape Verde); lat. 16° 49′ N., long. 25° 14′ W.

Near Station 354, May 7, 1876; off Azores; lat. 34° 22′ N., long. 34° 23′ W.

II. Deposit shells.

Station VIII., February 12, 1873; off Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Station 3, February 10, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1525 fathoms; bottom, hard ground.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 32B, April 3, 1873; St. Thomas to Bermuda; lat. 32° 10′ N., long. 64° 52′ W.; depth, 950 fathoms; bottom, coral mud.

[1] Angas, *Proc. Zool. Soc. Lond.*, 1871, p. 99.

[2] It is cited from Sicily after Allery by Tiberi, *Ann. Soc. Malacol. Belg.*, t. xiii. p. 76.

[3] *Comptes rendus*, t. xciv. p. 1201.

[4] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xix. p. 337.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 85, July 19, 1873; off Palma Island; lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long, 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Peraclis,[1] Forbes (*emend.*).

1836. *Heliconoides*, d'Orbigny (*pars*), Voyage dans l'Amérique Méridionale, t. v. p. 174.
1840. *Spirialis*, Eydoux et Souleyet (*pars*), Description sommaire de quelques Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 235.
1844. *Peracle*, Forbes, Report on the Mollusca and Radiata of the Ægean Sea, and on their distribution, considered as bearing on Geology, Rep. Brit. Assoc., 1843, p. 186.
1847. *Campylonaus*, Gray (*non* Benson), A List of the Genera of Recent Mollusca, their synonyms and types, Proc. Zool. Soc. Lond., 1847, p. 149.
1858. *Euromus*, A. and H. Adams, The Genera of Recent Mollusca, vol. ii. p. 613.
1876. *Limacina*, Jeffreys (*pars*), New and Peculiar Mollusca of the Family Eulimidæ and other Families of Gastropoda, as well as of the Pteropoda procured in the "Valorous" Expedition, Ann. and Mag. Nat. Hist., ser. 4, vol. xix. p. 337.

Characters and Description.—Shell with spire short but projecting, with bulging whorls rapidly increasing towards the very large and elongated aperture, which ends anteriorly in a very sharp angle. Spiral columella, prolonged into an elongated rostrum. No umbilicus. Surface smooth or finely reticulate.

Operculum subcircular, multispiral, left-handed.

Animal previously unknown, or supposed to be identical with that of the other Limacinidæ. Krohn[2] and Costa[3] have observed the living animal, but have not perceived the differences between it and the true *Limacina* type. The differences are as follows:—

1. Head distinct, prolonged into a proboscis analogous to that of the Cymbuliidæ (for example the old larvæ of *Gleba*).

[1] *Per*, meaning exaggeration, and *aclis*, a small javelin, in allusion to the long rostrum of the shell.

[2] Beiträge zur Entwickelungsgeschichte der Pteropoden und Heteropoden, p. 43, under the name of *Spirialis clathrata*.

[3] At Naples, under the name of *Spirialis recurvirostra*.

2. Lips with lateral angles, and united ventrally.

3. Tentacles symmetrical, of the same size and without sheath.

4. Posterior or opercular lobe of the foot broad at the base, instead of being slightly constricted as in *Limacina*, and less developed in proportion to the fins, which are large, long, truncated at their distal extremity, and without the small tentacle-like lobe.

5. Visceral ganglia forming three distinct masses, as in the Cymbuliidæ.

Observations.—I. Boas has made a mistake in figuring the operculum as twisted in a right-handed spiral.[1] The coil is left-handed, as d'Orbigny has represented it.[2] This arrangement is quite unique, for in all the operculate Mollusca the twisting of the operculum is in the opposite direction to that of the shell. *Atlanta* is the only right-handed Mollusc in which the operculum is coiled to the right. In all the left-handed operculate Molluscs the operculum is coiled to the right—*Limacina*,[3] *Triforis*,[4] *Læocochlis*.[5] *Peraclis* thus forms a remarkable exception.

II. The initial portion of the spire does not project, so that the apex is always obtuse.

III. Boas[6] notes in "*Limacina*" *reticulata* (=*Peraclis*) a small tentacle-like lobe on the fin as in *Limacina helicina;* this observation was made on an insufficiently preserved specimen, and has not been figured. I have examined not only the preserved specimen of the Challenger Expedition, but living specimens from the Mediterranean, and am able to state that the fin does not bear any lobe. Costa's figures[7] are perfectly correct in this respect. Boas must have mistaken a fold of the fin margin for the lobe.

D'Orbigny, the discoverer of the only species as yet known, considered it, as well as all the small forms of *Limacina* (the *Spirialis* of Souleyet), as Heteropods of the genus *Atlanta*. Forbes, who gave a second specific title to the form in question, and created for it the generic title *Peracle*, also regarded it as a Heteropod. Gray also regarded it as such, under the title *Campylonaus*.[8]

Souleyet was the first to place this form, with a third specific title, among the Pteropods, but was unable to investigate the animal. Subsequently Costa figured the paired fins of the animal, to which he gave a fourth specific title, and made its position as a Pteropod indisputable.

The structure of the genus has, however, remained quite unknown till now. I have been able to investigate it to some extent, and to show that it is of the highest interest

[1] Spolia atlantica, pl. iii. fig. 39.

[2] Voyage dans l'Amérique méridionale, t. v. pl. xii. fig. 39.

[3] Souleyet, Voyage de la Bonite, Zoologie, Mollusques, pl. xiii.; Sars, Mollusca regionis arcticæ Norvegiæ, pl. 29.

[4] Sars, *Ibid.*, pl. xviii. fig. 31.

[5] Sars, *Ibid.*, pl. xviii. fig. 29.

[6] Spolia atlantica, p. 50, note 2.

[7] *Annuario del Museo Zoologico della R. Univ. Napoli*, t. iv. pl. iv. fig. 12.

[8] *Proc. Zool. Soc. Lond.*, p. 149, 1847.

and importance in connection with the phylogenetic relations of the different families of Thecosomata. This I shall show in the anatomical portion of this Report.

Key to the Species.

A. Shell with simple lip, ... *Peraclis reticulata.*
B. Shell with lip exhibiting a tooth towards the suture, . . . *Peraclis bispinosa.*

*1. *Peraclis reticulata* (d'Orbigny) (Pl. I. figs. 7, 8).

1836. *Atlanta reticulata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 178, pl. xii. figs. 32–35, 39,
1840. *Spirialis clathrata*, Eydoux et Souleyet, Description sommaire de quelques Ptéropodes nouveaux ou imparfaitement connus, Revue Zoologique, t. iii. p. 138.
1844. *Peracle physoides*, Forbes, Report on the Mollusca and Radiata of the Ægean Sea, considered as bearing on geology, Rep. Brit. Assoc., 1843, p. 186.
1865. *Spirialis recurvirostra*, A. Costa, Di una nuova specie mediterranea di Molluschi "Pteropodi" del gen. Spirialis, Rendiconto d. real. Acad. d. Sci. Napoli, Anno iv. p. 125 (1867); Illustrazione della Spirialis recurvirostra, Annuario del Museo Zoologico della R. Univ. Napoli, t. iv. p. 56, pl. iv. fig. 12.
1870. *Spirialis physoides*, Jeffreys, in Carpenter and Jeffreys, Report on Deep-Sea Researches, Proc. Roy. Soc., vol. xix. p. 173.
1876. *Limacina physoides*, Jeffreys, New and Peculiar Mollusca of the Eulimidæ and other families of Gastropoda, as well as of the Pteropoda procured in the "Valorous" Expedition, Ann. and Mag. Nat. Hist., ser. 4, vol. xix. p. 337.

Characters and Description.—Shell elongated, formed of four bulging whorls, separated by a deep suture, and exhibiting a very slight keel on the side of the spire. The latter is somewhat short, obtuse at its apex, owing to the absence of projection of its initial portion; the last turn is very large. The opening is very large, elongated, and angled anteriorly. The columella is spiral with a prolonged pointed rostrum, which follows in its curvature the spiral of the columella. The surface exhibits a raised hexagonal reticulation, the sides of the hexagons bearing a regular row of minute teeth.

Colour.—Brownish-yellow.

Dimensions.—Maximum length 4 mm.; diameter 2·3 mm.

Operculum.—Glassy, with about four whorls; the surface of insertion small.

Animal.—Corresponding with the generic description.

Observations.—I. The reticulation of the surface becomes less marked from the apex of the spire towards the aperture. On the first whorls it projects markedly, while towards the mouth it almost disappears, and the colour of the shell becomes clearer. On the

empty shells, obtained from deep-sea deposits, the surface is perfectly smooth, and the shell is then clear and translucent, with a brownish-grey colour. This makes me think that the reticulation of the surface is confined to the epidermis.

II. The reason for the numerous titles applied to the present species is that the specimens have been studied in very different conditions.

Hitherto only one author has studied the living Pteropod in its adult state, namely Costa, who described it as *Spirialis recurvirostra*.

The two oldest descriptions of this species, that of d'Orbigny (under the title *Atlanta reticulata*) and that of Souleyet (under the title *Spirialis clathrata*), refer to young individuals. This is clearly shown from their smaller size ($2\frac{1}{2}$ mm.), the fewer turns in the spiral (three), the incompletely developed columellar rostrum, and the well-developed reticulation towards the aperture.

As to this reticulation, I have noticed that in the single specimen obtained on the Challenger Expedition, which was at the same stage as that observed by d'Orbigny and Souleyet, the markings are hexagonal, and not tetragonal as one might suppose with low-power examination.

Finally, the empty shells from deep-sea deposits, which have lost their superficial reticulation and brown colour, have been described by Forbes, Jeffreys (1871), and Fischer (1882)[1] under the specific title *physoides*.

Habitat.—Pacific Ocean, 20° S., 87° W. (d'Orbigny); perhaps in the Atlantic, at the Canaries (Krohn);[2] Mediterranean, Naples, during the day, at a depth of 100 metres or more.

The empty shells of this species have been dredged at various points in the Mediterranean; in the deep-sea dredgings of the "Travailleur" (Fischer); on the coast of Algiers ("Porcupine" Expedition, 1870, Station 51, 36° 55′ N., 1° 10′ E.); off Crete (Jeffreys),[3] in the Ægean Sea (Forbes), and finally in the North Atlantic ("Valorous" Expedition).[4]

Challenger Specimens.—I. Living.

Between Stations 264 and 265, August 24, 1875; on the route from the Sandwich Islands to Tahiti; lat. 13° 15′ N., long. 152° 2′ W.

This single specimen was stained and mounted in balsam. In order to examine the reticulation of the shell and the form of the fins, I had to extract the specimen from the balsam, and in this operation the shell was broken.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

[1] *Comptes rendus*, vol. xciv. p. 1201.

[2] Beiträge zur Entwickelungsgeschichte der Pteropoden und Heteropoden, p. 43.

[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xi. p. 401.

[4] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xix. p. 337.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

*2. *Peraclis bispinosa*, n. sp. (Pl. I. figs. 9, 10).

Characters and Description.—Shell elongated, smooth on the surface, with three or four bulging whorls on the spiral. The suture is milled, that is to say, the face of the whorls turned towards the spiral, which is somewhat depressed and slightly keeled, exhibits transverse ridges. In consequence of the twisting these ridges come to be disposed radially. The aperture is very large and long; the lip is hollowed out towards the suture, and bears in front of this hollowing a tooth directed outwards and towards the apex of the shell. Between this tooth and the excavation the margin of the aperture is slightly reflected inwards. The columella is prolonged into a very long rostrum which is straight throughout its entire length.

Colour.—Milky-white.

Operculum and animal unknown.

Dimensions.—Length 7·5 mm.; maximum diameter about 6 mm.

Observations.—I. In the specimens from deep-sea deposits (the only specimens known) the surface is smooth. Perhaps in the living specimens the surface may be reticulated as in *Peraclis reticulata*.

II. It is possible that the *Spirialis diversa* of Monterosato[1] was based on young specimens of *Peraclis bispinosa*. The above species has not yet been described, but Seguenza[2] notes in regard to fossil specimens that "*Spirialis diversa*" resembles "*Spirialis recurvirostra*" (*Peraclis reticulata*), and that it exhibits a toothed suture.

Challenger Specimens.—Deposit shells.

Station VIII., February 12, 1873; off Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 75, July 2, 1873; off Fayal (Azores); lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

[1] Nuova rivista delle Conchiglie mediterranee, p. 50.

[2] Studii paleontologici sulla fauna malacologica dei sedimenti pliocenici depositati a grandi profondita, p. 30.

Station 76, July 3, 1873; off the Azores; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Appendix to the Limacinidæ.

I. Gould has described,[1] under the name of "*Limacina* (*?*) *cucullata*," a Mollusc which he found to be different from the forms of *Limacina* previously described. For this he eventually proposed to erect the new genus *Agadina*.

The species and genus are, however, described and figured in a fashion so incomplete, and in addition characterised so insufficiently, that it is impossible to decide with any certainty as to their systematic position. One may, however, notice that according to Gould's figures the shell, which measures 6 mm. in diameter, exhibits a right-handed spiral which is not the case with any member of the Limacinidæ.

One must therefore entertain very grave doubts as to the position of this species. It seems to me most probable that it is a *Limacina antarctica* ill-drawn (*cf.* Gould's figure with fig. 4, Pl. II., after Hooker).

The specimen in question was obtained from the Antarctic Ocean (60° 0′ S., 106° 20′ E.). I have carefully sought among the Pteropods of the Challenger collection from that region, but have not been able to find anything corresponding to Gould's description.

A. and H. Adams have nevertheless retained[2] among the Limacinidæ the title *Agadina;* and in 1867 A. Adams described under this generic title two new species, but without any information as to the organisms.

In these, however, in contrast to the *Agadina* of Gould, the shell is perfectly left-handed, and the mouth does not in any way recall the bell-like form of *Limacina cucullata.* And furthermore the operculum of one of the forms is described (though without any notice of the direction of the coils) as multispiral. In this there is a resemblance to *Peraclis,* and there seems some reason therefore to regard the above types as true Limacinidæ.

I have found among the preparations of surface animals collected on the Challenger Expedition, which have been stained and mounted in balsam, one of the species described by A. Adams (*Agadina stimpsoni*), and another form of the same group, which is, however, quite distinct from either of the species above noted.

Having found several specimens of *Agadina stimpsoni* and of *Agadina,* n. sp., I have

[1] The Mollusca and Shells of the U.S. Exploring Expedition, p. 486, pl. li. fig. 601.

[2] *Proc. Zool. Soc. Lond.*, 1867, p. 309.

sacrificed one of each in order to examine the animals. To do this the specimens had to be removed from the balsam, and the shell destroyed by acetic acid.

I was then able to recognise that the so-called Limacinidæ were only Gastropod larvæ.

If it be useful to communicate new truths, it is not less necessary to destroy old errors. I have for this reason devoted a few sentences to show that the types of *Agadina* (in the sense in which A. and H. Adams use the term) are not really Pteropods.

*1. *Agadina stimpsoni*, A. Adams (Pl. I. figs. 11–14).

1867. *Agadina stimpsoni*, A. Adams, Description of New Species of Shells from Japan, Proc. Zool. Soc. Lond., 1867, p. 309, pl. xix. fig. 23.

Shell smooth, discoidal, without spire; three and a half whorls gradually increasing, rolled up in the same plane; rounded oblique aperture, with slightly bell-shaped margins; deep umbilicus, with slightly marked rays.

Colour.—Yellowish-white.

Dimensions.—1 mm. in diameter.

Operculum.—Horny, circular, externally concave, multispiral, with four and a half whorls gradually increasing, left-handed, surface of insertion very large.

Animal bearing on its head a four-lobed velum; dorsal pallial aperture; thick columellar muscle; foot large and strong, bifid in front, with a long broad creeping surface, and bearing the operculum at the posterior end; no fins.

The small size of this species, and the manipulations which the specimen had to undergo (the action of chloroform to remove the balsam, and of acetic acid to dissolve the shell), after having been stained and mounted in balsam for twelve years, did not allow me to study its structure in any detail. But what has been elucidated is sufficient to enable one to decide the group of Molluscs to which this form belongs, and the stage of development arrived at.

Habitat.—Kino Osima (Japan), A. Adams.

Challenger Specimens.—Living.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Near Station 206, January 9, 1875; China Sea; about lat. 17° 54′ N.; long. 117° 14′ E.

Station 216A, February 16, 1875; North of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

2. *Agadina gouldi*, A. Adams.

1867. *Agadina gouldi*, A. Adams, Description of New Species of Shells from Japan, Proc. Zool. Soc. Lond., 1867, p. 309, pl. xix. fig. 22.

Shell smooth, helicoid, formed of three and a half bulging and rapidly ascending whorls; spire not projecting above the last turn; oblique aperture with margins slightly expanded; umbilicus very narrow.

Dimensions.—1·5 mm. in diameter.

Operculum and animal unknown, but almost certainly like those of the two other species here enumerated.

Habitat.—Kino Osima (Japan), A. Adams.

*3. *Agadina*, n. sp. (Pl. I. figs. 15, 16).

Shell smooth, globular; spire short, but projecting beyond the last whorl; three bulging whorls, overlapping, and somewhat obliquely twisted; aperture rounded, oblique, with margins slightly expanded; umbilicus almost suppressed, covered by the last turn, which exhibits a keeled projection over this spot.

Operculum horny, circular, multispiral, with four and a half whorls, gradually increasing in a left-handed spiral; the surface of insertion very large.

Animal.—Without fins, resembling that of *Agadina stimpsoni*, but with the lobes of the velum more pointed, and the foot more elongated anteriorly.

Challenger Specimens.—I. Living.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

II. Deposit shells.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Since this form, like the two before it, is only the larval form of some Gastropod, there is no occasion to give it a specific title.

It is evident that these species cannot be ranked among the Pteropods. The absence of fins, the presence of a four-lobed velum when the shell has already three whorls on its spire, the presence of a foot with a creeping surface, are facts sufficient to demonstrate that we have here to deal with pelagic larvæ of streptoneural Gastropods.

This shows very distinctly the dangers of elaborating a zoological system without due regard to comparative anatomy.

Woodward's[1] statement that the true Limacinidæ may be distinguished by their left-handed twisting "from the fry of *Atlanta*, *Carinaria* and most other Gastropods" is thus quite inexact.

What enables one always to distinguish the Limacinidæ from the larvæ of Gastro-

[1] Manual of the Mollusca, 1856, p. 207.

pods, known by the title *Agadina*, even when the animals themselves are not known, is the horny, perfectly circular operculum of the latter (glassy in the Limacinidæ). In the operculum of *Agadina*, furthermore, the coils of the spire have a left-handed twist, and increase slowly, so that the nucleus of the spiral is much larger than in the Limacinidæ. The external surface is also concave; the aperture is obliquely rounded, with margins somewhat expanded, slightly thickened, and united, *i.e.*, the lip and the columellar margin are continuous by means of a small callus on the latter, which is absent in the Limacinidæ.

But to what streptoneural Gastropods do these larval "*Agadina*" forms belong? The marine left-handed Gastropods are not, indeed, very numerous. But it must be remembered that some Gastropods, with right-handed spirals, have their initial portion or nucleus twisted to the left. This is not improbably the case with the larval forms in question, for there the left-handed twisting of the operculum in all likelihood corresponds to a right-handed twisting of the shell.

I. To the group "*Agadina*" I also refer *Atlanta rotundata*, d'Orbigny,[1] which Souleyet regarded as a variety of *Limacina lesueuri* (his *Spirialis ventricosa*). The shell is discoidal and flattened; the spire in no way projects beyond the last coil; the mouth is rounded, and broader than high, with slightly thickened margins. The operculum figured by d'Orbigny appears concentric, but as the objects are small and difficult to define, it seems to me more likely that the operculum is multispiral, as in the other forms of "*Agadina*."

D'Orbigny's specimens were obtained in the Pacific Ocean, 36° S., 38° W. This form has only been chronicled on one other occasion, by Marrat,[2] on a voyage from South America to Liverpool. His specimens are deposited in the Liverpool Museum.

II. In closing this appendix to the family Limacinidæ it is necessary to note that the "*Agadina*" forms are not the only left-handed larvæ of Gastropods which have been taken for Pteropods. The same is true of *Limacina turritelloides*, Boas,[3] the empty shells of which I found in the Challenger collection (Station 216A, north of New Guinea). By every one familiar with the classification of Gastropods, this form would be at once recognised as a young left-handed *Cerithium* (*Triforis*), nor have I any doubt that this *Limacina turritelloides* is identical with the form which Craven has described under the title *Sinusigera perversa*.[4] Like *Triforis*, this exhibited a multispiral operculum, with right-handed twisting. Craven has, in fact, subsequently acknowledged[5] that his *Sinusigera perversa* (from the Indian Ocean) is only a pullus of *Triforis*.

[1] Voyage dans l'Amérique méridionale, t. v. p. 175, pl. xii. figs. 20–24.
[2] On a collection of Pteropods and Heteropods, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. ii. p. 229.
[3] Spolia atlantica, p. 49, pl. iii. fig. 35.
[4] Monographie du genre Sinusigera, *Ann. Soc. Malacol. Belg.*, t. xii. p. 112, pl. iii. fig. 4.
[5] Note sur le genre Sinusigera, *Ann. Soc. Malacol. Belg.*, t. xviii. p. xxvi.

Family II. Cavoliniidæ.

1841. *Hyalidæ*, d'Orbigny, Mollusques de Cuba, t. i. p. 70.
1842. *Cavolinidæ*, d'Orbigny, Paléontologie française, Terrains crétacés, t. ii. p. 4.
1842. *Cleodoridæ*, Gray, Synopsis of the Contents of the British Museum, p. 92.
1869. *Cliidæ*, Jeffreys, British Conchology, vol. v. p. 118 (*non* Woodward, 1856).
1875. *Orthoconques*, Fol, Sur le développement des Ptéropodes, Archives d. Zool. Expér., sér. 1, t. iv. p. 177.
incl. *Cuvieridæ*, Gray, 1842 = *Tripteridæ*, Gray, 1850.

Characters.—Shell external, calcareous, inoperculated, bilaterally symmetrical, not rolled up in a spiral, but at its apex often dorsally recurved. Animal with its pallial cavity ventral, and its columellar muscle dorsal; the anus situated on the left.

Description.—The shell has a variable form, which may always be referred to a hollow cone, more or less modified, flattened dorso-ventrally or circular in section. The apex is quite straight, recurved or truncated; the mouth broad or narrow; with longitudinal or transverse ribs, &c. The initial portion of the shell is generally distinct from the rest, and represents the embryonic shell.

The animal may be entirely retracted within the shell. The form of the fins and of the posterior lobe of the foot varies considerably. The mouth, the lips, and the tentacles resemble those of the Limacinidæ (except *Peraclis*).

In regard to the classification, as in the Limacinidæ, we find a large number of genera established by too zealous conchologists for the reception of the species belonging to this family. Abstracting genera based on Tertiary fossils, we find seventeen different generic titles applied to living Cavoliniidæ. These are enumerated in alphabetical order:—

Archonta, Montfort, 1810.
Balantium, Benson, 1837.
Cavolina, Abildgaard, 1791 (*non* Bruguière, 1792).
Cleodora, Péron and Lesueur, 1810.
Clio, Linné, 1767 (*non* Müller, 1776).
Creseis, Rang, 1828.
Cuvieria, Rang, 1827 (*non* Péron, 1807).
Cuvierina, Boas, 1886.
Diacria, Gray, 1842.
Hyalæa, Lamarck, 1801.
Hyalocylis, Fol, 1875.
Orbignyia, Adams, 1859.
Pleuropus, Eschscholtz, 1825.
Rheda, Humphreys, 1797.
Styliola, Lesueur, 1825.
Tricla, Oken, 1815 (*non* Retzius, 1788).
Triptera, Auctorum (*non* Quoy and Gaimard, 1824).

Of these seventeen titles:—

1. Three alone ought to be preserved as applicable to well-established genera—
(1) *Clio*; (2) *Cuvierina*; (3) *Cavolinia*.

2. Three designate well-marked subgeneric divisions of the genus *Clio*—

(1) *Creseis;* (2) *Hyalocylix;* (3) *Styliola.*

3. One represents the young state of some *Cavolinia: Pleuropus.*

4. Finally, the ten remaining titles may be preserved as synonyms of the three genera—

Balantium, *Cleodora*, } = *Clio.*

Cuvieria, *Triptera*, } = *Cuvierina.*

Archonta, *Diacria*, *Hyalæa*, *Orbignyia*, *Rheda*, *Tricla*, } = *Cavolinia.*

For the distinctive characters of the three genera *Clio*, *Cuvierina*, and *Cavolinia*, I refer to the synoptic table of genera (p. 8).

Clio,[1] Linné.

1756. *Clio*, Browne, The Civil and Natural History of Jamaica, p. 386.
1767. *Clio*, Linné, Systema naturæ, ed. 12, t. 1, pt. 2, p. 1094 (*non* O. F. Müller, 1776).
1810. *Cleodora*, Péron and Lesueur, Histoire de la famille des Mollusques Ptéropodes, Ann. Mus. Hist. Nat. Paris, t. xv. p. 66.
1825. *Styliola*, Lesueur, MS., in de Blainville, Manuel de Malacologie, p. 655.
1828. *Creseis*, Rang, Notice sur quelques Mollusques nouveaux appartenant au genre Cleodora, et établissement et monographie du sous-genre Creseis, Ann. d. Sci. Nat., sér. 1, t. xiii, p. 302.
1837. *Balantium*, Benson, Notice on Balantium, a Genus of the Pteropodous Mollusca, Journ. Asiat. Soc. Bengal, vol. vi. p. 151.
1875. *Hyalocylis*, Fol, Sur le développement de Ptéropodes, Archives d. Zool. Expér., t. iv. p. 177.

To the Thecosomata which I have united in this genus several generic titles have been applied, as may be seen from the synonyms.

Besides these generic titles, we have to note a considerable number of specific designations, of which only a very small fraction can be retained as applicable to really existing species of the genus *Clio.*

After abstracting all the so-called forms of *Clio* which are really Gymnosomata (see the first part of this Report),[2] there remains the following formidable list of specific titles attributed to living species. A certain number of extant species are also

[1] Mythological name.
[2] Zool. Chall. Exped., part lviii. pp. 44, 45.

found in the most recent Tertiary deposits, and have received other titles in that connection.

Creseis acicula, Rang.
Creseis acus, Eschscholtz.
Cleodora andreæ, Boas.
Hyalæa australis, d'Orbigny.
Cleodora balantium, Rang.
Balantium bicarinatum, Benson.
Cleodora brownii, de Blainville.
Creseis caligula, Eschscholtz.
Clio caudata, Linné.
Cleodora chaptalii, Souleyet.
Cleodora chierchiæ, Boas.
Creseis clava, Rang.
Creseis compressa, Eschscholtz.
Cleodora compressa, Souleyet.
Creseis conica, Eschscholtz.
Creseis conoidea, A. Costa.
Hyalæa corniformis, d'Orbigny.
Creseis cornucopiæ, Eschscholtz.
Cleodora curvata, Souleyet.
Hyalæa cuspidata, Bosc.
Clio depressa, Gray.
Cleodora exacuta, Gould.
Cleodora falcata, Gould.
Cleodora falcata, Pfeffer.
Cleodora flexa, Pfeffer.
Cleodora inflata, Souleyet.
Cleodora lamartinieri, Rang.
Hyalæa lanceolata, Lesueur.
Cleodora lessonii, Rang.
Cleodora lobata, Sowerby.
Cleodora martensii, Pfeffer.
Creseis monotis, Troschel.
Cleodora munda, Gould.
Cleodora obtusa, Quoy and Gaimard.
Cleodora occidentalis, Dall.
Clio pellucidum, Gray.
Creseis phæostoma, Troschel.
Cleodora placida, Gould.
Balantium politum, Craven, MS.
Cleodora pygmæa, Boas.
Clio pyramidata, Linné.
Cleodora quadrispinosa, Rang.
Styliola recta, Lesueur.
Balantium recurvum, Benson.
Clio rugosum, Gray.
Creseis rugulosa, Cantraine.
Creseis spinifera, Rang.
Creseis striata, Rang.
Creseis striata, Delle Chiaje.
Cleodora subula, Quoy and Gaimard.
Cleodora sulcata, Pfeffer.
Hyalæa tricuspidata, Bowdich.
Cleodora trifilis, Troschel.
Creseis unguis, Eschscholtz.
Creseis virgula, Rang.
Styliola vitrea, Verrill.
Creseis zonata, Delle Chiaje.

These fifty-seven names may be classified as follows :—

1. One may be discarded as not referring to a Pteropod, viz., *Creseis rugulosa*, Cantraine,[1] which is really a Gastropod of the genus *Cæcum*.

2. One refers to the adult stage of another genus of Thecosomatous Pteropods, viz., *Cleodora obtusa*, Quoy and Gaimard, which is probably the same as *Cuvierina columnella*.

[1] Malacologie Mediterranéenne et littorale, *Mém. Acad. d. Sci. Bruxelles*, t. xiii. p. 32.

3. Seven names refer to young stages of the Thecosomata of the genus *Cavolinia*, viz.:—

Cleodora compressa, Souleyet = *Cavolinia trispinosa*.
Cleodora curvata, Souleyet = *Cavolinia uncinata*.
Clio depressa, Gray = *Cleodora compressa*, Souleyet = *Cavolinia trispinosa*.
Clio pellucidum, Gray = *Pleuropus pellucidus*, Eschscholtz = *Cavolinia inflexa*.
Balantium rugosum, Gray = *Hyalæa rugosa*, d'Orbigny = *Cavolinia gibbosa*.
Cleodora pygmæa, Boas = *Cavolinia quadridentata*.
Cleodora trifilis, Troschel = *Cavolinia*, sp.

The attentive study of the forms designated by the remaining specific titles shows that thirty-three of these ought to be discarded, and considered only as synonyms of the fourteen remaining species.

Creseis acus, Eschscholtz, . = *Creseis acicula*, Rang.
Balantium bicarinatum, Benson, = *Cleodora balantium*, Rang.
Cleodora brownii, de Blainville, = *Clio pyramidata*, Linné.
Creseis caligula, Eschscholtz, . = *Creseis virgula*, Rang.
Clio caudata, Linné, . . = *? Clio pyramidata*, Linné.
Creseis clava, Rang, . . = *Creseis acicula*, Rang.
Creseis compressa, Eschscholtz, . = *Creseis striata*, Rang.
Creseis conoidea, O. Costa, . = *Creseis conica*, Eschscholtz.
Hyalæa corniformis, d'Orbigny, = *Creseis virgula*, Rang.
Creseis cornucopiæ, Eschscholtz, = *Creseis virgula*, Rang.
Cleodora exacuta, Gould, . = *Clio pyramidata*, Linné.
Cleodora falcata, Gould, . = *Creseis virgula*, Rang.
Cleodora falcata, Pfeffer, . = *Balantium politum*, Craven, MS.
Cleodora flexa, Pfeffer, . = *Creseis virgula*, Rang.
Cleodora inflata, Souleyet, . = *Cleodora balantium*, Rang (young).
Cleodora lamartinieri, Rang, . = *Clio pyramidata*, Linné.
Hyalæa lanceolata, Lesueur, . = *Clio pyramidata*, Linné.
Cleodora lessoni, Rang, . = *Hyalæa cuspidata*, Bosc.
Cleodora lobata, Sowerby, . = *Clio pyramidata*, Linné.
Cleodora martensii, Pfeffer, . = *Clio pyramidata*, Linné.
Creseis monotis, Troschel, . = *Creseis striata*, Rang.
Cleodora munda, Gould, . = *Creseis virgula*, Rang.
Creseis phæostoma, Troschel, . = *Creseis striata*, Rang.
Creseis placida, Gould, . = *Creseis virgula*, Rang.
Cleodora quadrispinosa, Rang, = *Hyalæa cuspidata*, Bosc.
Styliola recta, Lesueur, . = *Cleodora subula*, Quoy and Gaimard.

Balantium recurvum, Benson, .	= *Cleodora balantium*, Rang.
Creseis spinifera, Rang, .	= *Cleodora subula*, Quoy and Gaimard.
Cleodora striata, Delle Chiaje, .	= *Creseis conica*, Eschscholtz.
Hyalæa tricuspidata, Bowdich,	= *Hyalæa cuspidata*, Bosc.
Creseis unguis, Eschscholtz, .	= *Creseis virgula*, Rang.
Styliola vitrea, Verrill, .	= *Creseis conica*, Eschscholtz.
Creseis zonata, Delle Chiaje, .	= *Creseis striata*, Rang.

The genus *Clio* thus includes fourteen real species, of which eleven are included among the spoils of the Challenger.

Creseis virgula, Rang.	*Cleodora sulcata*, Pfeffer.
Creseis acicula, Rang.	*Cleodora chaptalii*, Souleyet.
Creseis conica, Eschscholtz.	*Cleodora balantium*, Rang.
Cleodora chierchiæ, Boas.	*Balantium politum*, Craven, MS.
Creseis striata, Rang.	*Cleodora andreæ*, Boas.
Cleodora subula, Quoy and Gaimard.	*Clio pyramidata*, Linné.[1]
Hyalæa australis, d'Orbigny.	*Hyalæa cuspidata*, Bosc.

This genus is thus the richest of the Thecosomata, and indeed of the entire group of Pteropods. It is also that which exhibits the greatest variety of forms. It may well be asked whether all the species should be ranged in uniform succession in a homogeneous series, or whether further classification is not possible.

Rang, Philippi, Souleyet, Gould, Pfeffer, Boas, &c., are of opinion that all the species ought to bear the same generic title, and the anatomical researches of Souleyet have shown that the structure is nearly the same in the different forms examined.

On the other hand, the conchologists who are never afraid of a multiplicity of names generally divide into three or four genera the series of forms which we comprise under the title *Clio*.

But the attempt towards classification most worthy of attention is certainly that of Fol,[2] who bases his arrangement on the ontogenetic development of Mediterranean forms.

Fol divides the living species of *Clio* into the four following genera :—

Hyalocylis, Fol ; type *Creseis striata*, Rang.
Styliola, Lesueur ; type *Cleodora subula*, Quoy and Gaimard.
Cleodora, Péron and Lesueur ; type *Clio pyramidata*, Linné.
Creseis, Rang ; type *Creseis acicula*, Rang.

[1] *Cleodora occidentalis*, Dall, appears to be nearly related to *Clio pyramidata*. From an unpublished figure which Mr. Dall has been good enough to send me, it possesses between each fin and the posterior lobe of the foot a conical tentacle, which is not found in *Clio pyramidata ;* but as I have not been able to examine specimens of "*Cleodora occidentalis*" I cannot give a decided opinion on this question.

[2] Sur le développement des Mollusques Ptéropodes, *Archives d. Zool. Expér.*, sér. 1, t. iv. pp. 177, 178.

This classification has been adopted in Fischer's[1] Manual of Conchology, and in part also in that of Tryon.[2]

It is however necessary to remark that Fol distributes these four genera in a manner altogether peculiar, separating most of the species from the group at present under discussion. Thus in our family of Cavoliniidæ (his Orthoconques) he distinguishes, abstracting the genus *Cuvierina*, three subgroups,—Hyaléacées, Styliolacées, and Creseidées. *Hyalocylix* is referred to the first, along with the *Cavolinia* forms. *Styliola* and *Cleodora* are included in the Styliolacées. *Creseis* is placed among the Creseidées.

I cannot admit that these different forms are separated in this way, or in any way equally deep and trenchant.

Fol's distinctions, which are based exclusively on embryonic characters, form an insufficient foundation for the classification of the adults. For it must be noted that the forms in question are pelagic larvæ in which, as Fritz Müller long ago remarked,[3] true genetic characters are mingled with those which are merely adaptive, and provisionally acquired for the free, independent, pelagic larval life.

On the other hand, the different forms of *Clio* exhibit a type of structure which unites them in one and distinguishes them from the other Thecosomata, and especially from the "Hyaléacées" of Fol (among which the "*Cleodora*" forms are certainly more nearly allied than the *Hyalocylix*).

Nevertheless, it cannot be denied that among the species which I have united within the genus *Clio* there are several distinct types, separated not only by the embryonic differences on which Fol's classification is based, but also by certain structural features, which will be discussed in the anatomical portion of this Report. Yet, at the same time, I maintain that these distinctions are not of sufficient import to justify the establishment of separate genera.

I therefore propose to consider the different types above referred to as subgenera of *Clio*, and since these subgeneric divisions correspond approximately to the genera recognised by Fol, I shall preserve as designations of these subgeneric sections the four titles which Fol has used, viz., *Creseis*, *Hyalocylix*, *Styliola*, *Clio* (= *Cleodora*). As to *Balantium*, I do not find that it exhibits any characters which would warrant its being separated from the subgenus *Clio* (= *Cleodora*), *s. str.*

Within these four sections, the species known to be genuine are distributed in the following fashion :—

1. Subgenus *Creseis*.

Creseis virgula, Rang.
Creseis conica, Eschscholtz.
Creseis acicula, Rang.
Cleodora chierchiæ, Boas.

[1] Manuel de Conchyliologie, pp. 435–437.
[2] Structural and Systematic Conchology, vol. ii. pp. 90, 91.
[3] Facts and Arguments for Darwin, p. 114.

2. Subgenus *Hyalocylix.*

Creseis striata, Rang.

3. Subgenus *Styliola.*

Cleodora subula, Quoy and Gaimard.

4. Subgenus *Clio, s. str.*

Balantium politum, Craven, MS.
Cleodora andreæ, Boas.
Cleodora balantium, Rang.
Hylæa australis, d'Orbigny.
Cleodora sulcata, Pfeffer.
Clio pyramidata, Linné.
Hyalæa cuspidata, Bosc.

The four sections may be distinguished as follows :—

I. Shell without lateral keels.
  1. Shell without dorsal longitudinal groove.
    A. Shell with a circular section, ... 1. *Creseis.*
    B. Shell flattened dorso-ventrally, with transverse grooves over its entire length, ... 2. *Hyalocylix.*
  2. Shell with a dorsal longitudinal groove, ... 3. *Styliola.*
II. Shell with lateral keels, ... 4. *Clio*, including *Balantium.*

Subgenus *Creseis*,[1] Rang (*s. str.*).

1828. *Creseis*, Rang, Notice sur quelques Mollusques nouveaux appartenant au genre Cleodora, &c., Ann. d. Sci. Nat., sér. 1, t. xiii. p. 302.
Styliola, Auctorum, *non* Lesueur.

Characters and Description.—Shell elongated, of conical form, with a circular transverse section, with a smooth surface on its initial portion at least, with the embryonic portion not marked off by a deep constriction, with a rounded apex.

Animal with the left tentacle very rudimentary, the fin exhibiting a small narrow projecting lobe on the proximal half of the dorsal (anterior) margin, the opening of the mantle as broad as that of the shell.

[1] Mythological name.

Key to the Species.

I. Shell entirely destitute of transverse grooves.
  1. Shell at its initial portion of a dark brown colour.
    A. Shell with a very marked and somewhat abrupt dorsal curve, and with the transverse diameter increasing rapidly at the point of curvature, 1. *Clio virgula.*
    B. Shell with a slight curvature, and with the transverse diameter increasing uniformly, ... 2. *Clio conica.*
  2. Shell straight, much elongated, with the initial extremity of a whitish colour, ... 3. *Clio acicula.*
II. Shell with transverse grooves all over its broader portion, ... 4. *Clio chierchiæ.*

*1. *Clio* (*Creseis*) *virgula* (Rang).

1828. *Creseis virgula*, Rang, Notice sur quelques Mollusques nouveaux du genre Cleodora, &c., Ann. d. Sci. Nat., sér. 1, t. xiii. p. 316, pl. xvii. fig. 2.
1829. *Creseis unguis*, Eschscholtz, Zoologischer Atlas, Heft iii. p. 17, pl. xv. fig. 4.
1829. *Creseis cornucopiæ*, Eschscholtz, *Ibid.*, p. 17, pl. xv. fig. 5.
1829. *Creseis caligula*, Eschscholtz, *Ibid.*, p. 18, pl. xv. fig. 6.
1836. *Hyalæa corniformis*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 120, pl. viii. figs. 20–23.
1850. *Styliola virgula*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 17.
1850. *Styliola corniformis*, Gray, *Ibid.*, p. 18.
1852. *Cleodora virgula*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 196, pl. viii. figs. 18–25.
1852. *Cleodora munda*, Gould, The Mollusca and Shells of the U.S. Exploring Expedition, p. 489, pl. li. fig. 607.
1852. *Cleodora placida*, Gould, *Ibid.*, p. 489, pl. li. fig. 606.
1852. *Cleodora falcata*, Gould, *Ibid.*, p. 490, pl. li. fig. 608.
1879. *Cleodora flexa*, Pfeffer, Bericht über die von S. M. Schiff "Gazelle" und Dr. Jagor gesammelten Pteropoden, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1879, p. 241, figs. 15, 16.

For description and figures I refer to Souleyet, *loc. cit.* (see the synonymy above).

Habitat.—Atlantic Ocean, from 41° 25′ N. (Verrill) to 35° 10′ S. (Boas), both towards the new and the old world.

Indian Ocean; from the Gulf of Bengal to 29° S., especially towards the west (south-east of Arabia, Blanford) to 65° E.

Pacific Ocean: eastern portion, from 35° N., about the Bay of Yedo ("Galathea" Expedition), to 32° S., New South Wales (British Museum), China Sea ("Galathea" Expedition), Coral Sea (Pfeffer); central portion, from 24° N. ("Vettor Pisani" Expedition) to 30° S. (Knocker); North-east Pacific (Gould as "*Cleodora falcata*"); South-east Pacific, Juan Fernandez Island (d'Orbigny).

Challenger Specimens.—I. Living specimens.

Station 106, August 25, 1873; St. Vincent (Cape Verde) to St. Paul's Rock; lat. 1° 47′ N., long. 24° 26′ W.

Between Stations 162 and 163, April 3, 1874; Melbourne to Sydney, lat. 38° 7′ S., long. 149° 18′ E.

Station 164A, June 13, 1874; off Sydney; lat. 34° 9′ S., long. 151° 55′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 209, January 22, 1875; Manila to Samboangan; lat. 10° 14′ N., long. 123° 54′ E.

On February 6, 1875; at Samboangan; lat. 6° 40′ N., long. 122° 57′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

Between Stations 229 and 230, April 3, 1875; Admiralty Islands to Yokohama; lat. 24° 49′ N., long. 138° 34′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

Between Stations 264 and 265, August 24, 1875; Sandwich Islands to Tahiti; lat. 13° 15′ N., long. 152° 2′ W.

Station 299, December 14, 1875; Valparaiso to Gulf of Penas; lat. 33° 31′ S., long. 74° 43′ W.

Station 348, April 9, 1876; Ascension Island to St. Vincent (Cape Verde); lat. 3° 10′ N., long. 14° 51′ W.

On April 26, 1876; off St. Vincent; lat. 16° 49′ N., long. 25° 14′ W.

On April 29, 1876; off St. Vincent; lat. 18° 8′ N., long. 30° 5′ W.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., ong. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

*2. *Clio* (*Creseis*) *conica* (Eschscholtz) (Pl. II. figs. 1, 2).

1829. *Creseis conica*, Eschscholtz, Zoologischer Atlas, Heft iii. p. 17, pl. xv. fig. 3.
1830. *Creseis striata*, Delle Chiaje, Memorie sulla storia e notomia degli animali senza vertebre, pl. lxxxii. fig. 12.
1869. *Creseis conica*, A. Costa, Pteropodi del golfo di Napoli, Rendiconto d. reale Accad. d. Sci. Napoli, 1869, p. 58.
1872. (?) *Styliola vitrea*, Verrill, Recent Additions to the Molluscan Fauna of New England and the adjacent waters, &c., Amer. Journ. Sci. and Arts, vol. iii. p. 284, pl. vi. fig. 7.
1873. *Creseis conoidea*, A. Costa, Pteropodi della Fauna del Regno di Napoli, p. 17, pl. iv. fig. 6.

Characters and Description.—Shell conical, moderately elongated; smooth over its entire surface; a very slight and regular dorsal curvature; the transverse diameter increasing gently and uniformly; the posterior extremity of a dark brown colour; the embryonic portion separated by a well-marked constriction, and thinning off towards the somewhat slender apex (Pl. II. fig. 2).

Animal like that of *Clio* (*Creseis*) *virgula*, but distinguished at first sight by this marked feature that the mass formed by the stomach and liver is situated much further forward than in the above species. For while in *Clio virgula* the broad œsophagus is very long, and the mass in question removed from the posterior extremity of the shield (pallial gland) by more than the length of the latter, in *Clio conica* it is situated immediately behind the shield. With this difference there is obviously correlated the abrupt and precocious enlargement of the shell in *Clio virgula*, and the gentle uniform increase in *Clio conica*.

Observations.—I. There can be no doubt in regard to the species figured by Eschscholtz. It is not *Clio* (*Creseis*) *acicula*, since it is much too short in proportion, and has its posterior extremity of a dark brown colour. It is not *Clio* (*Creseis*) *virgula*, since it exhibits neither the abrupt curvature nor the precocious enlargement of diameter exhibited by that form, and since the visceral mass is situated anteriorly. Neither is it *Clio* (*Styliola*) *subula*, although Gray[1] and Souleyet[2] so regard it. The absence of a dorsal groove, the colour of the posterior extremity, and the shortness of the posterior lobe of the foot are enough to show that it is not.

The "*Creseis conica*" of Eschscholtz is in fact the species which one finds at Naples, and in all probability that which Delle Chiaje noted under the name of "*Creseis striata*."

A. Costa, thinking he had discovered a new species, described this form as *Creseis conica*, ignoring the fact that this title had been already used by Eschscholtz. Becoming aware of this, but failing to recognise the identity of the two forms, he changed the name *conica* to *conoidea*.

[1] Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 17.
[2] Histoire naturelle des Mollusques Ptéropodes, p. 55.

II. The figure given by Eschscholtz has been referred by Gray and by Souleyet (not without hesitation) to *Clio subula*; I have indicated above that this identification is impossible.

On the other hand Boas, who is of opinion [1] that *Clio virgula* and *Clio acicula* should be united, figures [2] under the title "*Cleodora acicula*" a specimen which undoubtedly belongs to the species under discussion. At the same time he designates as "*Cleodora acicula*" [3] the specimens of the "Vettor Pisani" Expedition, which also resemble *Clio conica*. The latter is distinguished from *Clio acicula* not only in the characters of the shell noted above, but also in the conformation of the liver, which agrees with what is found in *Clio virgula*. *Clio conica* is beyond dispute more nearly allied to *Clio virgula* than to *Clio acicula*.

Dimensions.—Besides being distinguished by certain characters of the shell and of the animal, *Clio conica* is also marked by its size, which never exceeds 7 mm.

Habitat.—Atlantic Ocean: coast of Brazil (Eschscholtz); coasts of North America (if, as I believe, *Styliola vitrea* = *Clio conica*).

Mediterranean: Naples.

Pacific Ocean: eastern portion, 0° N., 84° 40′ W. ("Vettor Pisani" Expedition).

Challenger Specimens.—Deposit shells.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

*3. *Clio* (*Creseis*) *acicula* (Rang).

1828. *Creseis acicula*, Rang, Notice sur quelques Mollusques nouveaux du genre Cleodora, &c., Ann. d. Sci. Nat., sér. 1, t. xiii. p. 318, pl. xvii. fig. 6.
1828. *Creseis clava*, Rang, *Ibid.*, p. 317, pl. xvii. fig. 5.
1829. *Creseis acus*, Eschscholtz, Zoologischer Atlas, Heft iii. p. 17, pl. xv. fig. 2.
1836. *Hyalæa aciculata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 123, pl. viii. figs. 29–31.
1850. *Styliola recta*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 18.
1852. *Cleodora acicula*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 194, pl. viii. figs. 10–17.

For description and figures, see Souleyet, *loc. cit.* (in the above list of synonyms).

Habitat.—Atlantic Ocean, from 48° N. to the Cape of Good Hope (Pfeffer), and to 40° S. (Knocker). Mediterranean: Naples, &c. Indian Ocean: from the Gulf of Bengal to 29° S. (Boas); from Zanzibar (Pfeffer) to near Australia (95° E.).

Pacific Ocean: West, China Sea (Boas); Central Pacific, from 10° N. (Knocker) to 23° S. (Pfeffer), and towards 153° W.; Eastern Pacific towards the equator, 88° W. ("Vettor Pisani" Expedition).

[1] Spolia atlantica, p. 202. [2] *Ibid.*, pl. vi. fig. 94. [3] *Ibid.*, p. 61.

Challenger Specimens.—I. Living specimens.

Station VIIF., February 2, 1873; off Madeira; lat. 32° 27′ 0″ N., long. 16° 40′ 30″ W.

Station 62, June 18, 1873; Bermuda to Azores; lat. 35° 7′ N., long. 52° 32′ W.

Station 63, June 19, 1873; Bermuda to Azores; lat. 35° 29′ N., long. 50° 53′ W.

Station 81, July 13, 1873; Azores to Madeira; lat. 34° 11′ N., long. 19° 52′ W.

Station 164A, June 13, 1874; off Sydney; lat. 34° 9′ S., long. 151° 55′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Near Station 190, September 13, 1874; south of the Arrou Islands; lat. 8° 18′ S., long. 135° 7′ E.

Station 200, October 23, 1874; Amboina to Samboangan; lat. 6° 47′ N., long. 122° 28′ E.

Station 201, October 26, 1874; Samboangan to Manila; lat. 7° 3′ N., long. 121° 48′ E.

Station 209, January 22, 1875; Manila to Samboangan; lat. 10° 14′ N., long. 123° 54′ E.

On February 5, 1875; at Samboangan.

On February 6, 1875; at Samboangan; lat. 6° 40′ N., long. 122° 57′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

Station 237, June 17, 1875; Yokohama to Sandwich Islands; lat. 34° 37′ N., long. 140° 32′ E.

Station 256, July 21, 1875; Yokohama to Sandwich Islands; lat. 30° 22′ N., long. 154° 56′ W.

August—September, 1875; Sandwich to Tahiti.

Between Stations 292 and 293, October 31, 1875; Tahiti to Valparaiso, lat. 38° 50′ S., long. 108° 6′ W.

Station 323, February 28, 1876; Falkland Islands to Rio de la Plata; lat. 35° 39′ S., long. 50° 47′ W.

Station 326, March 3, 1876; Rio de Janeiro to Tristan da Cunha; lat. 37° 3′ S., long. 44° 17′ W.

Station 327, March 4, 1876; Rio de Janeiro to Tristan da Cunha; lat. 36° 48′ S., long. 42° 45′ W.

Station 339, March 23, 1876; Tristan da Cunha to Ascension Island; lat. 17° 26′ S., long. 13° 52′ W.

Station 349, April 10, 1876; Ascension Island to St. Vincent (Cape Verde); lat. 5° 28′ N., long. 14° 38′ W.

On April 26, 1876; off St. Vincent; lat. 16° 49′ N., long. 25° 14′ W.

On April 29, 1876; off St. Vincent; lat. 18° 8′ N., long. 30° 5′ W.

Station 353, May 3, 1876; St. Vincent to Azores; lat. 26° 21′ N., long. 33° 37′ W.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 35c, April 22, 1873; off Bermuda; lat. 32° 15′ N., long. 65° 8′ W.; depth, 1950 fathoms; bottom, Globigerina ooze.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Note.

According to Boas, the three preceding species are really identical. Little desirous as I am to multiply the number of species, I cannot admit the accuracy of this identification.

Clio acicula is distinguished from the two other species, not only by some characters of the shell (posterior portion whitish, opaque, instead of being transparent and dark brown), but also by some structural features, and especially by the nature of the liver, which is represented by a much reduced mass of acini, while the pyloric cæcum attains very conspicuous development.

It must be allowed that the other two species (*Clio virgula* and *Clio acicula*) are nearer neighbours, but the diagnostic characters which have been noted above make a union of the two species impossible.

4. *Clio* (*Creseis*) *chierchiæ* (Boas).

1886. *Cleodora chierchiæ*, Boas, Spolia atlantica, p. 62, pl. iii. fig. 39ter.

Characters and Description.—This minute species (2·5 mm. in length) is very distinctly characterised and is readily distinguished from all the other members of the group by the fact that the shell, over about two-thirds of its length, is covered with

transverse grooves, which are closely approximated and equidistant like those of *Clio striata*. This cannot be regarded as teratological, for this species has been collected in different localities and in great abundance. Nor is it a young stage, for none of the observed specimens exceeded the size indicated. *Clio chierchiæ* differs notably from *Clio striata* in the absence of curvature on the shell, by the form of the embryonic shell, and by the form of the fins.

Habitat.—Different localities near Panama ("Vettor Pisani" Expedition).

Subgenus *Hyalocylix*,[1] Fol.

1875. *Hyalocylis*, Fol, Sur le développement des Ptéropodes, Archives d. Zool Expér., sér. 1, t. iv. p. 177.
Creseis (*pars*), Rang.
Styliola (*pars*) auctorum (*non* Lesueur).
Cleodora (*pars*), Souleyet, Boas, &c.

Characters and Description.—Shell conical, slightly compressed dorso-ventrally (oval transverse section); the apex recurved dorsally; the surface marked with transverse grooves from the well-marked constriction defining the embryonic shell on to the aperture.

The animal has a conspicuous left tentacle; the fin has a marginal non-muscular area, situated towards the dorso-lateral corner; the posterior lobe of the foot is extremely short; the aperture of the mantle as large as that of the shell.

This "subgenus" includes only a single species.

*5. *Clio* (*Hyalocylix*) *striata* (Rang) (Pl. II. fig. 3).

1828. *Creseis striata*, Rang, Notice sur quelques Mollusques appartenant au genre Cleodora, &c., Ann. d. Sci. Nat., sér. 1, t. xiii. p. 315, pl. xv. fig. 7.
1829. *Creseis compressa*, Eschscholtz, Zoologischer Atlas, Heft iii. p. 17, pl. xv. fig. 7.
1830. *Creseis zonata*, Delle Chiaje, Memorie sulla storia e notomia degli animali senza vertebre, pl. lxxxii. fig. 9.
1850. *Styliola striata*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 18.
1854. *Creseis phæostoma*, Troschel, Beiträge zur Kenntniss der Pteropoden, Archiv f. Naturgesch., 1854, p. 206, pl. viii. figs. 5–7.

For description and figures, I refer to Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 191, pl. viii. figs. 1–4.

Observations.—I. In the preserved specimens the embryonic shell is almost always deciduous, so that this portion is hardly known. Fol alone[2] has figured it from young specimens. Having observed it on the living adults, I am able to give a more definite

[1] From ὑάλεος, glassy, κύλιξ, cup.
[2] Sur le développement des Ptéropodes, *Archives d. Zool. Expér.*, sér. 1, t. iv. figs. 2, 4.

representation (Pl. II. fig. 3). This embryonic portion has a rounded apex, it is distinctly expanded, and separated by a well-marked constriction from the rest of the shell. It seems most closely to resemble that of *Clio australis*.

II. Troschel has figured,[1] under the name of *Creseis monotis*, a small Thecosomatous form "without shell." This seems to me to be only a bad representation of a *Clio striata*. I have often observed living specimens of this species which had lost their shell.

III. The name "*Creseis fasciata*," Delle Chiaje, which is cited by several authors, is the Italian title given to this form by Delle Chiaje. The Latin designation, which the same authority uses, is *Creseis zonata* (see the synonyms above).

Habitat.—Atlantic Ocean: from 36° 30′ N. to 40° S., especially towards the Old World. Mediterranean, on the coasts of Europe and Africa.

Indian Ocean: from the Gulf of Bengal to 25° S. (Boas). Red Sea (Issel).

Pacific Ocean: China Sea (Boas); New South Wales (British Museum); Equatorial Pacific, 147° 48′ W. (Knocker); Chili ("Vettor Pisani" Expedition).

Challenger Specimens.—I. Living specimens.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 200, October 23, 1874; Amboina to Samboangan; lat. 6° 47′ N., long. 122° 28′ E.

Station 201, October 26, 1874; Samboangan to Manila; lat. 7° 3′ N., long. 121° 48′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

Between Stations 247 and 248, July 4, 1875; Yokohama to Sandwich Islands; lat. 36° 42′ N., long. 179° 50′ W.

Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

Station 282, October 7, 1875; Tahiti to Valparaiso; lat. 23° 46′ S., long. 149° 59′ W.

Station 337, March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ S., long. 13° 36′ W.

On May 12, 1876; off the Azores; lat. 42° 52′ N., long. 28° 54′ W.

II. Deposit shells.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

[1] Beiträge zur Kenntniss der Pteropoden, *Archiv f. Naturgesch.*, 1854, Bd. i. p. 288, pl. viii. figs. 8, 9.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Subgenus *Styliola*,[1] Lesueur.

1825. *Styliola*, Lesueur, in de Blainville, Manuel de Malacologie, p. 655.

Characters and Description.—Shell conical, straight, considerably elongated; the surface smooth, with a dorsal groove not parallel to the axis of the shell, but slightly oblique, turning from left to right, with only the anterior extremity (which ends in a rostrum) in the median line; the embryonic portion only vaguely separated from the rest of the shell, and ending in a pointed apex.

The animal with the two tentacles distinctly visible; the transparent, non-muscular, marginal area of the fin situated towards the middle of the lateral margin; the posterior lobe of the foot is long.

Observation.—The name *Styliola*, first used in 1825 by Lesueur in the Manuel de Malacologie of de Blainville, has been regarded by English and American conchologists as synonymous with the later title, *Creseis*, Rang. This opinion is based, however, on a misinterpretation of the typical species, *Styliola recta*, Lesueur (*sine descriptione*), which has been taken by these authors for *Clio acicula*. But the descriptions given of the genus *Styliola* enable one to infer that *Styliola recta* is really *Clio subula*, and not *Clio acicula*.

The difference between *Styliola* (in the usage of Lesueur) and *Creseis* (*s. str.*) may be gathered from a comparison of the two descriptions given above. The structural features, as will be shown in the Anatomical Report, go to show that *Styliola* is much more nearly related to *Clio* (*s. str.*) than to *Creseis*, and on the contrary that the forms included under the latter designation have retained some more archaic characters of the Limacinidæ.

This subgeneric section includes only a single species.

[1] Diminutive of στύλος, column.

*6. *Clio* (*Styliola*) *subula* (Quoy and Gaimard).

1825. *Styliola recta*, Lesueur, in de Blainville, Manuel de Malacologie, p. 655 (*nomen tantum*).
1827. *Cleodora subula*, Quoy et Gaimard, Observations zoologiques faites à bord de l'Astrolabe, &c., Ann. d. Sci. Nat., sér. 1, t. x. p. 233, pl. viii. D. figs. 1–3.
1828. *Creseis spinifera*, Rang, Notice sur quelques Mollusques nouveaux du genre Cleodora, &c., Ann. d. Sci. Nat., sér. 1, t. xiii. p. 313, pl. xvii. fig. 1.
1828. *Creseis subula*, Rang, *Ibid.*, pl. xviii. fig. 1.
1836. *Hyalæa subula*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 119, pl. viii. figs. 15–19.
1850. *Styliola subula*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 17.
1852. *Cleodora subulata*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 191, pl. viii. figs. 5–9.

For description and figures, see Souleyet (*loc. cit. supra*).

Habitat.—Atlantic Ocean; from 41° N. to 25° S. (Pfeffer), towards the coasts both of the Old World and of America (Antilles, &c.); Mediterranean, Naples, &c. The empty shells have been dredged at numerous localities in the Mediterranean (Tunis, &c.).

Indian Ocean; southern portion, from 17° 20′ S. to 38° 28′ S. (Boas); on the coasts of Africa (Zanzibar, Port Natal), and towards Australia.

Pacific Ocean; eastern portion, Malay Archipelago (Amboina, New Guinea), east coast of Australia to 32° S. (Pfeffer, Angas); western portion, from 23° N. to 35° S.

Boas has remarked[1] the absence of this species below the equator, and notes the same in regard to *Cavolinia gibbosa*. This has been noticed in regard to other Molluscs, as I have remarked for instance in regard to *Lasæa rubra*.[2] It is, however, less explicable in the case of Molluscs which can shift their ground so readily as the Pteropods. But as a matter of fact, *Clio subula* is found in the Pacific Ocean both to the south and to the north of the equator.

Challenger Specimens.—I. Living specimens.

Near Station 160, March 15, 1874; off Melbourne; lat. 39° 45′ S., long. 140° 40′ E.

Near Station 160, March 16, 1874; off Melbourne; lat. 39° 22′ S., long. 142° 27′ E.

Station 164A, June 13, 1874; off Sydney; lat. 34° 9′ S., long. 151° 55′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Near Station 230, April 3, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 138° 34′ E.

On April 4, 1875; Admiralty Island to Yokohama; lat. 25° 33′ N., long. 137° 57′ E.

Station 251, July 10, 1875; Yokohama to Sandwich Islands; lat. 37° 37′ N., long. 163° 26′ W.

Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

[1] Spolia atlantica, p. 66. [2] Sur l'aire de dispersion de Lasæa rubra, *Bull. Scient. Nord*, 1886, p. 235.

Station 256, July 21, 1875; Yokohama to Sandwich Islands; lat. 30° 22′ N., long. 154° 56′ W.

Station 294, November 3, 1875; Tahiti to Valparaiso; lat. 39° 22′ S., long. 98° 46′ W.

Station 332, March 10, 1876; Rio de Janeiro to Tristan da Cunha; lat. 37° 29′ S., long. 27° 31′ W.

On April 28, 1876; off St. Vincent; lat. 17° 47′ N., long. 28° 28′ W.

On May 12, 1876; off the Azores; lat. 42° 52′ N., long. 28° 54′ W.

II. Deposit shells.

Station VIII., February 12, 1873; off the Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Station 3, February 18, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1525 fathoms; bottom, hard ground.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 35c, April 22, 1873; off Bermuda; lat. 32° 15′ N., long. 65° 8′ W.; depth, 1950 fathoms; bottom, Globigerina ooze.

Station 75, July 2, 1873; off Fayal (Azores); lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 164, June 12, 1874; off Sydney; lat. 34° 8′ S., long. 152° 0′ E.; depth, 950 fathoms; bottom, green mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Station 335, March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom, Pteropod ooze.

Subgenus *Clio*, Linné.

1767. *Clio*, Linné, Systema Naturæ, ed. 12, p. 1094 (*non* Müller, 1776).
1810. *Cleodora*, Péron et Lesueur, Histoire de la Famille des Mollusques Ptéropodes, Ann. Mus. Hist. Nat. Paris, t. xv. p. 66.
1829. *Balantium*, Anonymous (Children, *fide* Gray), Journ. Roy. Inst., vol. xv. p. 220.

Characters and Description.—Shell, of a somewhat angular form, colourless, compressed dorso-ventrally, with lateral keels. An anterior transverse section is thus always angular laterally. There is generally a crest or rib extending longitudinally along the back, and usually projecting. The embryonic shell varies in form, but is always definitely separate from the rest.

Animal.—The aperture of the mantle is smaller than the aperture of the shell; the margins are laterally united for a certain distance, as in *Cavolinia;* the simple lateral prolongations of the mantle corresponding to the lateral keels hardly extend beyond the margin of the shell; the fin has a non-muscular space situated towards the middle of the distal margin; the left tentacle is always distinctly visible; there is a triangular dorsal lobe between the two fins, and formed by the union of the two lips; the anus is situated far in front, near the aperture of the mantle.

Key to the Species.

I. Shell with lateral keels over its entire length.
  1. Shell with dorsal ribs very slightly projecting.
    A. Shell with a broad posterior portion, ... *Clio andreæ.*
    B. Shell with a narrow posterior portion, ... *Clio polita.*
  2. Shell with dorsal ribs markedly projecting.
    A. Shell with three dorsal ribs, ... *Clio balantium.*
    B. Shell with five dorsal ribs, ... *Clio chaptali.*

II. Shell with no lateral keels on the posterior portion.
  1. Shell without lateral spines.
    A. Shell with the lateral margins almost parallel, ... *Clio australis.*
    B. Shell with the lateral margins very divergent.
      a. Transverse grooves on the posterior portion, dorsal ribs multiple, . *Clio sulcata.*
      b. No posterior transverse grooves, the dorsal ribs undivided, . *Clio pyramidata.*
  2. Shell with lateral spines, ... *Clio cuspidata.*

7. *Clio andreæ* (Boas).

1886. *Cleodora andreæ*, Boas, Spolia atlantica, p. 80, pl. i. fig. 1; pl. ii. fig. 12.

This species, which closely resembles *Clio polita* (see below), is distinguished by its greater breadth, especially in the posterior portion, by its two equally bulging faces, by its more marked flattening, by its curvature, especially localised on the posterior

portion, and contrasting with the straight anterior region. This curvature is dorsal over the greater portion of its length, but is slightly ventral towards the apex. The embryonic portion is not separated by a projecting ring from the rest of the shell. The length is also considerable, 20 mm.

Habitat.—South Atlantic Ocean, 33° 30′ S., 1° 0′ W.

*8. *Clio polita* (Craven, MS.) (Pl. II. figs. 4–6).

1880. *Cleodora falcata*, Pfeffer, Die Pteropoden des Hamburger Museums, Abhandl. Naturwiss. Ver. Hamburg, Bd. vii. p. 96, pl. vii. fig. 19 (not Gould, 1852).
Balantium politum, Craven, MS. (British Museum).

Characters and Description.—Shell, slender, narrow posteriorly, smooth over its entire surface, more bulging ventrally than dorsally, exhibiting on the former surface four slight longitudinal grooves, but none on the latter. The lateral keels are well-marked, sharp, projecting, parallel to the axis of the shell, more delicate than those of *Clio balantium*, and not hollow-edged. The dorsal curvature is uniform and continuous. Pfeffer has indeed figured two specimens of this species, one of which exhibits a regular curvature (fig. 19*b*), while the other is much recurved posteriorly (fig. 19*a*), and has based his description on the latter. But all the specimens which I have seen from the collections of the "Valorous" and the Challenger also resemble fig. 19*b*, which I am therefore warranted in regarding as the normal type. The middle of the lips does not project anteriorly. The embryonic shell has a bulging oval form, rounded on its posterior portion, and separated from the rest of the shell by a well-marked constriction, limited by a small projecting ring.

The animal I have not observed. The soft parts are "dunkel-schwarz-violett" according to Pfeffer.

Dimensions, 10 to 11 mm.

Habitat.—North Atlantic Ocean, Davis Strait ("Valorous" Expedition), 44° N., 31° W. (Hamburg Museum).

Challenger Specimens.—Deposit shells.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

*9. *Clio balantium* (Rang).

1829. *Balantium recurvum*, Anonymous (Children, *fide* Gray), Journ. Roy. Inst., vol. xv. p. 220, pl. vii. fig. 107.
1834. *Cleodora balantium*, Rang, Magasin de Zoologie, 1834, pl. xliv.
1836. *Hyalæa balantium*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 116, pl. viii. figs. 1–4.
1837. *Balantium bicarinatum*, Benson, Notice on Balantium, a Genus of the Pteropodous Mollusca, Journ. Asiat. Soc. Bengal, vol. vi. p. 151.
1852. *Cleodora inflata*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 188, pl. vii. figs. 17–19 (young).

For description and figures, I refer to Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 186, pl. vii. figs. 11–16.

Habitat.—Atlantic Ocean; intertropical (21° 30′ N. to 19° 30′ S., Boas); 44° N. (Atlantic?) (Pfeffer); toward 40° N., coast of America (Verrill, fragments).[1]

Indian Ocean; exclusively in the southern portion, 33° S. towards Africa (Boas), towards Australia (Pfeffer), Islands of St. Paul and Amsterdam (Benson).

Challenger Specimens.—Living.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E. (young).

*10. *Clio chaptali* (Souleyet) (Pl. II. fig. 7).

1852. *Cleodora chaptali*, Souleyet, Voyage de la Bonite, Zoologie, p. 183, pl. vii. figs. 1–5.

The above form appears to be a distinct species, but very strictly localised, for it has not been reobserved since its discovery by Souleyet. I only know a single adult specimen (dry shell), which is deposited in the British Museum.

Characters and Description.—Shell somewhat bulging, with its apex recurved dorsally, with its lateral edges uniformly and markedly diverging, in contrast to *Clio balantium*, where they describe a sigmoid curve. The lateral keels are sharp and not hollow-edged, as they are in *Clio balantium;* they run parallel to the axis of the body, and are not at all turned ventrally; this admits of the ventral surface being as bulging as the dorsal. The latter bears five longitudinal ribs, instead of three as in *Clio balantium*. The middle of the lips hardly projects anteriorly. The embryonic shell is separated from the rest by a well-marked constriction, in front of which the shell broadens out again. The embryonic portion, however, in contrast to that of *Clio balantium*, does not enlarge behind the constriction, and is terminated posteriorly by a much-pointed apex (Pl. II. fig. 7).

The animal, according to Souleyet, very closely resembles *Clio balantium*.

[1] Catalogue of the Marine Mollusca added to the fauna of New England during the past ten years, *Trans. Connect. Acad.*, vol. v. p. 557.

Habitat.—Atlantic Ocean; near the Cape of Good Hope (Souleyet).

Challenger Specimen.—Living, young.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

*11. *Clio australis* (d'Orbigny) (not Bruguière) (Pl. II. fig. 8).

1836. *Hyalæa australis*,[1] d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 117, pl. viii. figs. 9–11.

1850. *Balantium australe*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 15.

1852. *Cleodora australis*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 189, pl. viii. figs. 20–25.

For figures and description, see Souleyet (*loc. cit.*).

Habitat.—This species appears to have a geographical distribution like that of *Spongiobranchæa australis* and *Limacina australis*, that is to say, localised in the southern regions of the three great oceans around the South Pole.

Cape Horn (d'Orbigny); South-east Pacific (48° S., 86° W., Souleyet); (?) south-east of the Cape of Good Hope, 38° 50′ S. (Boas).

Challenger Specimens.—Living.

Station 159, March 10, 1874; Termination Land to Melbourne; lat. 47° 25′ S., long. 130° 22′ E.

Observations.—Boas[2] has united with the present species *Clio sulcata*, Pfeffer. But the latter is certainly a distinct species, also collected towards the South Pole by the Challenger Expedition, and the embryonic shell[3] which Boas has figured as that of "*Cleodora australis*" is precisely similar to *Clio sulcata*, and very different from that of *Clio australis* (Pl. II. fig. 8). For in the latter the embryonic shell is separated from the other portion by a much broader and deeper constriction, and is terminated posteriorly by a rounded extremity.

*12. *Clio sulcata* (Pfeffer) (Pl. II. figs. 9–11).

1879. *Cleodora sulcata*, Pfeffer, Uebersicht der auf S. M. Schiff Gazelle, und von Dr. Jagor gesammelten Pteropoden, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1879, p. 240, figs. 11, 12.

Characters and Description.—*Shell* slender, with a very slight curvature, with the ventral surface only slightly projecting, but not re-entrant. The surface adorned with transverse ridges; nine longitudinal ridges occur in close proximity on the anterior portion of the dorsal surface. The margins of the aperture, as Pfeffer has noted, are very fragile,

[1] The name *Hyalæa australis* was already used in 1816 by Péron (Voyage de découvertes aux terres australes, pl. xxxi. fig. 5), but it only occurs on the plate, and no description is given. As the figure refers to *Cavolinia tridentata*, I think the specific title *australis* may be fitly retained for the above species of *Clio*.

[2] Spolia atlantica, p. 68.

[3] *Ibid.*, pl. iv. fig. 46.

so that it is difficult to describe the exact form of the lips, though this is probably intermediate between that of *Clio australis* and that of *Clio pyramidata*. The embryonic shell is almost directly continuous with the other portion, from which it is separated only by a narrow groove. The posterior extremity is pointed.

The figure 17*c* of Pfeffer (pl. vii., *loc. cit.*) represents the curvature of the shell as if it were ventral. The specimen figured must then have been abnormal, for in all the specimens of *Clio sulcata* which I have seen the curvature was dorsal, as it is indeed in all the curved Cavoliniidæ.

The animal resembles that of neighbouring species (*Clio australis* and *Clio pyramidata*). The left tentacle is readily visible; the posterior lobe of the foot is of considerable length, and the other external characters are those of the genus *Clio* in the strict sense. There are no lateral prolongations of the margins of the mantle.

This form is undoubtedly a distinct species which cannot be referred either to *Clio australis* (as by Boas) or to *Clio pyramidata*. It differs from both in the fact that the ventral surface of the shell is not at all re-entrant. And further it differs from *Clio australis* (with which it has a closely analogous geographical distribution) in its much more divergent lateral margins and in its embryonic shell, as may be seen by comparing the figures of the two species. This form was the *Clio* observed on the last expedition of the "Astrolabe," to which I have referred in my Report on the Gymnosomata.[1]

Dimensions.—The shell measures 2 cm. in length.

Habitat.—Like *Clio australis*, this form was found in the southern region of the Pacific Ocean, lat. 50° 34′ S., long. 83° 44′ W., and lat. 45° 35′ S., long. 122° 1′ W. (Pfeffer); also in the Southern Ocean, near Kerguelen Island; and in the Antarctic Ocean (see the following Challenger localities).

Challenger Specimens.—Living specimens.

Station 150, February 2, 1874; Heard Island; lat. 52° 4′ S., long. 71° 22′ E.

Between Stations 154 and 155, February 21, 1874; in vicinity of Antarctic ice; lat. 63° 30′ S., long. 89° 8′ E.

Station 156, February 26, 1874; in vicinity of Antarctic ice; lat. 62° 26′ S., long. 95° 44′ E.

*13. *Clio pyramidata*, Linné.

1767. *Clio pyramidata*, Linné, Systema Naturæ, ed. 12, p. 1094.
1813. *Hyalæa lanceolata*, Lesueur, Mémoire sur quelques espèces d'animaux mollusques et radiaires recueillis dans la Méditerranée près de Nice, Nouv. Bull. Soc. Philom. Paris, t. iii. p. 284, pl. v. fig. 3.
1825. *Cleodora brownii*, De Blainville, Manuel de Malacologie, pl. xlvi. fig. 1.
1836. *Hyalæa pyramidata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 113, pl. vii. figs. 25–29.
1841. *Cleodora lamartinieri*, Rang, in d'Orbigny, Mollusques de Cuba, p. 83.

[1] Zool. Chall. Exped., pt. lviii. p. 62.

1852. *Cleodora lanceolata*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 179, pl. vi. figs. 17–25.

1852. *Cleodora exacuta*, Gould, The Mollusca and Shells of the U.S. Exploring Expedition, p. 488, pl. li. fig. 605.

1877. *Cleodora labiata*, Sowerby, in Reeve, Conchologia iconica, t. xx., Pteropoda, fig. 26.

1880. *Cleodora martensii*, Pfeffer, Die Pteropoden des Hamburger Museums, Abhandl. d. Naturw. Ver. Hamburg, Bd. vii. p. 95, pl. vii. fig. 16.

For figures and description, see Souleyet (*loc. cit.*).

Habitat.—This species has a cosmopolitan distribution, and exhibits noteworthy variations in form.

The most northerly locality is Spitzbergen (British Museum), then Bergen, Iceland, Davis Strait, the whole of the Atlantic towards both continents and down to 40° S., and all the Mediterranean.

Indian Ocean; from the Gulf of Bengal to 40° S. (Boas), off the coasts of Africa, Natal, Zanzibar (Pfeffer), and as far as Australia, Swan River (British Museum).

Pacific Ocean; western portion, Japan, Gulf of Yedo ("Galathea" Expedition), Yellow Sea (British Museum), China Sea (Boas), Malay Archipelago, Eastern Australia to 40° S. (Pfeffer); North-east Pacific, 44° N., 154° W. (Gould, as "*Cleodora exacuta*"); South-east Pacific, 27° 11′ S., 88° 52′ W. ("Galathea" Expedition).

Challenger Specimens.—I. Living.

Station 62, June, 18, 1873; Bermuda to Azores; lat. 35° 7′ N., long. 52° 32′ W.

Station 63, June 19, 1873; Bermuda to Azores; lat. 35° 29′ N., long. 50° 53′ W.

Station 142, December 18, 1873; Cape of Good Hope to parallel of 46° S.; lat. 35° 4′ S., long. 18° 37′ E.

Near Station 160, March 15, 1874; off Melbourne; lat. 39° 45′ S., long. 140° 40′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

Station 251, July 10, 1875; Yokohama to Sandwich Islands; lat. 37° 37′ N., long. 163° 26′ W.

Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

Station 256, July 21, 1875; Yokohama to Sandwich Islands; lat. 30° 22′ N., long. 154° 56′ W.

Station 293, November 1, 1875; Tahiti to Valparaiso; lat. 39° 4′ S., long. 105° 5′ W.

Station 332, March 10, 1876; Rio de Janeiro to Tristan da Cunha; lat. 37° 29′ S., long. 27° 31′ W.

Between Stations 332 and 333, April 28, 1876; off St. Vincent (Cape Verde); lat. 17° 47′ N., long. 28° 28′ W.

On May 12, 1876; off the Azores; lat. 42° 52′ N., long. 28° 54′ W.

II. Deposit shells.

Station VIII., February 12, 1873; off Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Station 3, February 18, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1525 fathoms; bottom, hard ground.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 35c, April 22, 1873; off Bermuda; lat. 32° 15′ N., long. 65° 8′ W.; depth, 1950 fathoms; bottom, Globigerina ooze.

Station 75, July 2, 1873; off Fayal (Azores); lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

Station 76, July 3, 1873; off the Azores; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 164, June 12, 1874; off Sydney; lat. 34° 8′ S., long. 152° 0′ E.; depth, 950 fathoms; bottom, green mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Station 246, July 2, 1875; Yokohama to Sandwich Islands; lat. 36° 10′ N., long. 178° 0′ E.; depth, 2050 fathoms; bottom, Globigerina ooze.

Station 323, February 28, 1876; Falkland Islands to Rio de la Plata; lat. 35° 39′ S., long. 50° 47′ W.; depth, 1900 fathoms; bottom, blue mud.

Station 335, March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S long. 13° 5′ W.; depth 1425 fathoms; bottom, Pteropod ooze.

*14. *Clio cuspidata* (Bosc).

1802. *Hyalæa cuspidata*, Bosc, Histoire naturelle des Coquilles, t. ii. p. 241, pl. ix. figs. 5–7.
1820. *Hyalæa tricuspidata*, Bowdich, Elements of Conchology, pl. vi. fig. 1.
1830. *Cleodora lessonii*, Rang, MS., in Lesson, Voyage autour du Monde de la Coquille, t. ii. pt. i. p. 247, pl. x. fig. 1.
1833. *Cleodora cuspidata*, Quoy et Gaimard, Voyage de l'Astrolabe, Zoologie, t. ii. p. 384, pl. xxvii. figs. 1–5.
1852. *? Cleodora quadrispinosa*, Rang, Histoire naturelle des Mollusques Ptéropodes, pl. v. fig. 6.

For figures and description see Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 176, pl. vi. figs. 11–16.

Habitat.—Atlantic Ocean, from 60° N. to 37° S.; Mediterranean; Indian Ocean, from Ceylon to 42° S., from Africa to Australia.

It has not been recorded from the Pacific previously to the Challenger Expedition.

Challenger Specimens.—I. Living specimens.

Near Station 230, April 4, 1875; Admiralty Islands to Yokohama; lat. 25° 33′ N., long. 137° 57′ E.

Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Cuvierina,[1] Boas.

1825. *Cuvieria*, Rang, Description de deux genres nouveaux appartenant à la classe des Ptéropodes, Ann. d. Sci. Nat., sér. 1, t. xii. p. 322 (not Péron, 1807).
Triptera, auctorum, not Quoy and Gaimard.
1886. *Cuvierina*, Boas, Spolia atlantica, p. 131.

Characters and Description.—*Shell* straight, elongated, with a smooth surface, with the posterior half conical and pointed, generally caducous in the adult. The anterior half is swollen medianly, but constricted behind the aperture. A partition, concave in front, is found towards the middle of the entire length of the shell, and close beside this the truncation is formed. The transverse section is circular, except towards the aperture, where it is a little compressed, and appears somewhat reniform. Behind

[1] Named after Cuvier.

the aperture the shell is contracted, but bulges out again towards the partition. The embryonic portion is separated from the rest of the shell by a shallow constriction.

Animal with the aperture of the mantle as large as that of the shell, with fins as in *Clio* (*Styliola*) *subula* and other species of *Clio* in the strict sense. The posterior portion of the foot is slightly hollowed out in its middle region.

Adult specimens with the posterior portion intact are very rare. Benson[1] and d'Orbigny[2] were the first independently to describe the form of the entire shell, which was not known to Rang when he established the genus "*Cuvieria*."

Cuvierina is nearly allied to *Clio*, so much so indeed that Souleyet[3] was inclined to unite "*Cuvieria*" with "*Cleodora*" as a single division or subgenus. Similarly, according to Lesson,[4] Rang proposed in his unpublished Monograph to unite the above forms in a subgenus of "*Cleodora*."

Among all the species of the genus *Clio*, *Clio* (*Styliola*) *subula* exhibits the closest affinity with *Cuvierina*. Nevertheless, the constriction of the shell behind the mouth, the median partition, and the constant truncation, definitely distinguish *Cuvierina* from all the forms of *Clio*, and warrant its position as a distinct genus.

But, on the other hand, there is no sufficient reason to establish a distinct family, as Gray[5] and the brothers Adams[6] have done.

It is an entire abuse of nomenclature to apply to this genus the title *Triptera*, Quoy and Gaimard. Nothing could be more uncertain than what *Triptera rosea*[7] really is, as the title is applied to a Pteropod without a shell.

The genus *Cuvierina* includes only a single living species.

* *Cuvierina columnella* (Rang).

1824. *? Cleodora obtusa*, Quoy et Gaimard, Voyage de l'Uranie, Zoologie, p. 415, pl. lxvi. fig. 5.

1827. *Cuvieria columnella*, Rang, Description de deux nouveaux genres appartenant à la classe des Ptéropodes, Ann. d. Sci. Nat., sér. 1, t. xiii. p. 323, pl. xlv. figs. 1–8.

1835. *Cuvieria oryza*, Benson, Corrected characters of the genus Cuvieria and Notice of a second species inhabiting the tropical Indian Ocean, Journ. Asiat. Soc. Bengal, vol. iv. p. 698.

1850. *Triptera columnella*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 23.

[1] Corrected characters of the genus Cuvieria of Rang, &c., *Journ. Asiat. Soc. Bengal*, vol. iv. p. 698, 1835.
[2] Voyage dans l'Amérique méridionale, t. v. pp. 124, 125, pl. viii. fig. 36.
[3] Voyage de la Bonite, Zoologie, t. ii. p. 203.
[4] Voyage autour du Monde de la Coquille.
[5] Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 23.
[6] The Genera of Recent Mollusca, vol. i. p. 54.
[7] Description de cinq genres de Mollusques, &c., *Ann. d. Sci. Nat.*, sér. 1, t. vi. p. 76, pl. ii. fig. 5, 1825.

1850. *Cuvieria urceolaris*, Mørch, Catalogus conchyliorum quae reliquit C. P. Kjerulf, p. 32.

1879. *Triptera columella* (*sic*), Pfeffer, Uebersicht der auf S.M. Schiff "Gazelle" und von Dr. Jagor gesammelten Pteropoden, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1879, p. 243, fig. 18.

1879. *Triptera cancellata*, Pfeffer, *Ibid.*, p. 243, fig. 19.

For description and figures I refer to Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 205, pl. xii. The best figure of the complete shell is to be found in the Spolia atlantica of Boas, pl. iii. fig. 39.

Habitat.—Atlantic Ocean; from 43° 23′ N. (Boas) to 40° S., both towards the New and Old Worlds. According to Souleyet, this species has been found towards Cape Horn, but this appears to me to require confirmation. The locality Spitzbergen, noted in the British Museum, is certainly erroneous.

Indian Ocean; from the Gulf of Bengal (British Museum) to 35° 30′ S., from Africa (Zanzibar, the Cape, &c.) to Australia.

Pacific Ocean; western portion, China Sea (Boas), Malay Archipelago, east coast of Australia (Pfeffer and Angas); eastern portion, from 23° N. to 42° S. (Knocker).

Challenger Specimens.—I. Living specimens.

Station 53, May 26, 1873; Halifax to Bermuda; lat. 36° 30′ N., long. 63° 40′ W.

Station 62, June 18, 1873; Bermuda to Azores; lat. 35° 7′ N., long. 52° 32′ W.

Station 63, June 19, 1873; Bermuda to Azores; lat. 35° 29′ N., long. 50° 53′ W.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

Station 280, October 4, 1875; Tahiti to Valparaiso; lat. 18° 40′ S., long. 149° 52′ W.

Station 288, October 21, 1875; Tahiti to Valparaiso; lat. 40° 3′ S., long. 132° 58′ W.

Near Station 288, October 22, 1875; Tahiti to Valparaiso; lat. 40° 0′ S., long. 131° 36′ W.

Station 294, November 3, 1875; Tahiti to Valparaiso; lat. 39° 22′ S., long. 98° 46′ W.

Near Station 354, May 7, 1876; St. Vincent towards Azores; lat. 34° 22′ S., long. 34° 23′ W.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144′ 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 335, March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S., long. 13° 5′ W.; depth 1425 fathoms; bottom, Pteropod ooze.

Cavolinia,[1] Abildgaard.

1791. *Cavolina*, Abildgaard, Om Cavolina natans, Anomia tridentata Forskalæi, Skriv. Naturhist. Selsk., Bd. i. Heft. ii. p. 173 (*non* Bruguière, 1792).
1797. *Rheda*, Humphreys, Museum Calonnianum.
1801. *Hyalæa*, Lamarck, Système des animaux sans vertèbres, p. 139.
1810. *Archonta*, Montfort, Conchyliologie sytématique, t. ii. p. 50.
1815. *Tricla*, Oken, Lehrbuch der Zoologie, t. i. p. 327 (*err. typ.* 273).
1825. *Pleuropus*, Eschscholtz, Bericht über die Zoologische Ausbeute während der Reise von Cronstadt bis St. Peter und Paul, Oken, Isis, 1825, Bd. i. p. 735.
1842. *Diacria*, Gray, Synopsis of the Contents of the British Museum.
1859. *Orbignyia*, A. Adams, On synonyms and habitats of Cavolinia, Diacria, and Pleuropus, Ann. and Mag. Nat. Hist., ser. 3, vol. iii. p. 45.

Characters and Description.—The shell, which is generally of a horny brown colour, is especially characterised (in the adult state, of course) by its much-contracted aperture, which is, however, very broad transversely. The lateral portions of this aperture, which are narrower than the middle part, are almost separated from it by a more or less developed tooth rising from the ventral lip and fitting into a dorsal depression. The dorsal lip, which is longer than the ventral, is always more or less ventrally recurved; the ventral lip, much recurved dorsally, is constricted a little in front of the aperture, and then reflected ventrally. The ventral surface is always bulging. The special form of *Cavolinia* depends on the fact that the sides of the shell

[1] Named after Cavolini or Caulini.

diverge abruptly outwards so that the lips appear much prolonged anteriorly. The sides of the shell are often prolonged into a more or less projecting point. The embryonic shell is not separated by a distinct constriction, except in *Cavolinia trispinosa* and *Cavolinia quadridentata*.

The animal somewhat resembles in its external characters the species of *Clio* strictly so called. Its special characters chiefly consist in the breadth of the posterior lobe of the foot and in the presence of lateral prolongations of the mantle, which project from the lateral portions of the aperture (side clefts of the adult) and may cover a considerable portion of the shell.

Many authors (A. Adams, Gray, Fischer, Boas, &c.) call this genus "*Cavolinia*, Gioeni," and do so on the authority of Abildgaard, according to whom Gioeni first used this title in his work entitled "Descrizione di una nuova Famiglia e di un nuovo Genere di Testacei trovati nel littorali di Catania." This small memoir (8vo and not 4to as is always noted) is somewhat rare, and does not appear to have been actually seen by the authors who cite it from Abildgaard. For in the memoir itself it may be seen that while Gioeni has indeed represented *Cavolinia tridentata* in his figures xiv.–xvi., he does not give it its title. Caulini is referred to on p. xxvii, note *a*, as the first to observe the animal of this species, but there is no question of naming in his honour the "nuovo Genere di Testacei."

The name "*Cavolina*" (em. *Cavolinia*) only dates from 1791, and its author was Abildgaard. It has, nevertheless, the priority over *Cavolinia*, Bruguière, which was not published till 1792,[1] and ought to be employed in preference to the title *Hyalæa*, Lamarck, 1801.

Although the shells of *Cavolinia* have a much constricted aperture, different individuals within the same species may exhibit very noteworthy divergences in regard to size. The difference is sometimes very striking, so that in some species the diameter of certain individuals may be four times that of others (*Cavolinia longirostris*, after Boas).[2]

From this fact it has been inferred (Pfeffer)[3] that, in order to grow, the shells of *Cavolinia* must first of all lose all the contracted portion by absorption, since growth can only take place by the apposition of fresh material at the margin of the aperture.

But this hypothesis of partial absorption is altogether imaginary. As Boas has already pointed out,[4] there is no trace of a line of reabsorption on the shells of large size, and it is further a very strong argument against the theory that the posterior (oldest) portion of the small individuals does not correspond exactly to the homologous portion

[1] Encyclopédie Méthodique; Histoire naturelle des Vers, t. i.
[2] Spolia atlantica, p. 206.
[3] Die Pteropoden des Hamburger Museums, *Abhandl. Naturw. Ver. Hamburg*, t. vii. p. 75.
[4] Spolia atlantica, p. 207.

of the large specimens, which, however, it is bound to do, if in the latter the contracted portion is absorbed and the posterior portion alone left. This residue ought obviously to be identical and superposable in individuals of any size whatever.

The small-sized specimens, like the large, are individuals which will not increase further, which have attained their limit of growth, as is otherwise indicated by the complete development of the reproductive system. The smaller size of the shell depends on its surface being developed along a curve with smaller radius than in the large-sized individuals.

On the other hand, there are several forms of Cavoliniidæ, to which distinct specific titles are given, notably those which Boas calls "Hyales plates," where the union of the two lips of the shell by the so-called "appareil de fermeture" has not been developed. All these forms, as we shall immediately show, are individuals which have not yet attained sexual maturity, and belong to species already known, as Cantraine first suspected.

But this condition of immaturity, associated as it undoubtedly is with reduced development of the reproductive organs,[1] may be prolonged to a very late stage, and the shell may be very large before the formation of the "appareil de fermeture." This can be easily demonstrated by examining a large number of specimens, as for instance of *Cavolinia tridentata* at Naples. In this form, to which our attention was first directed by Dr. Paul Schiemenz, one finds, even at the same stage of development, considerable difference in size.

It is certain that there are notable differences in the size of adult specimens (with completely developed reproductive organs, and with perfected closing apparatus); and the theory of the partial absorption of the shell must be dismissed.

But as I have already pointed out, those young stages which we have discussed have been regarded as distinct species, and have been referred either to the genus *Cavolinia* (*Hyalæa*) or to the genus *Clio* (*Cleodora*), or to a special genus, *Pleuropus*.

And besides these entirely superfluous terms, we also find for the forms which properly belong to this genus a profuse superabundance of specific titles, just as in the cases of *Clio* and the Limacinidæ.

As these Thecosomata are pelagic animals with a very wide geographical distribution, there is no inconsiderable exhibition of variation in the form of the shell. Thus have arisen numerous variations, distinguished by very slight divergences. But on the basis of minimal distinctions, conchologists have not hesitated to establish a large number of "new" species.

If we abstract the titles which ought to be referred to other genera altogether[2]

[1] See Gegenbaur (*Hyalæa complanata*), Untersuchungen über Pteropoden und Heteropoden, pl. i. fig. 1; Souleyet (*Hyalæa lævigata*), Voyage de la Bonite, Zoologie, pl. v. fig. 14; Huxley (*Cleodora curvata*), On the Morphology of the Cephalous Mollusca, *Phil. Trans.*, 1853, pl. iv. figs. 4, 5.

[2] Also Nudibranchs, designated *Cavolina* (Bruguière).

(d'Orbigny placed in the genus *Hyalæa* = *Cavolinia* all the members of the family Cavoliniidæ), or even to other groups, and confine our attention to the forms really belonging to this genus, we shall find, for extant species, fifty-four specific titles, of which three are used with several connotations, which increases the mischief still further.

Hyalæa affinis, d'Orbigny.
Hyalæa angulata, Souleyet.
Hyalæa australis, Péron.
Hyalæa chemnitziana, Péron and Lesueur.
Hyalæa complanata, Gegenbaur.
Cleodora compressa, Souleyet.
Hyalæa cornea, Lamarck.
Hyalæa costata, Pfeffer.
Hyalæa cumingii, Sowerby.
Cleodora curvata, Souleyet.
Hyalæa cuspidata, Delle Chiaje (*non* Bosc).
Hyalæa depressa, Bivona (*non* d'Orbigny).
Hyalæa depressa, d'Orbigny.
Hyalæa ecaudata, Lesueur.
Hyalæa elongata, Lesueur.
Hyalæa femorata, Gould.
Hyalæa fissirostris, Benson.
Hyalæa flava, d'Orbigny.
Hyalæa forskahlii, Lesueur.
Hyalæa gegenbauri, Pfeffer.
Hyalæa gibbosa, Rang.
Hyalæa globulosa, Rang.
Pleuropus hargeri, Verrill.
Hyalæa imitans, Pfeffer.
Hyalæa inermis, Gould.
Hyalæa inflexa, Lesueur.
Hyalæa intermedia, Sowerby.
Hyalæa labiata, d'Orbigny.
Hyalæa lævigata, d'Orbigny.
Hyalæa limbata, d'Orbigny.
Pleuropus longifilis, Troschel.
Hyalæa longirostris, Lesueur.
Hyalæa minuta, Sowerby.
Hyalæa mucronata, Quoy and Gaimard.
Cavolina natans, Abildgaard.
Hyalæa obtusa, Sowerby.
Hyalæa papilionacea, Quoy and Gaimard.
Pleuropus pellucidus, Eschscholtz.
Hyalæa peroni, Lesueur.
Cavolina pisum, Mørch.
Cleodora pygmæa, Boas.
Hyalæa quadridentata, Lesueur.
Hyalæa quadrispinosa, d'Orbigny.
Hyalæa reeviana, Dunker.
Hyalæa rotundata, Boas.
Hyalæa rugosa, d'Orbigny.
Hyalæa teniobranchea, Péron and Lesueur.
Hyalæa triacantha, Bronn.
Anomia tridentata, Forskål.
Cleodora trifilis, Troschel.
Hyalæa trispinosa, Lesueur.
Hyalæa truncata, Krauss (*non* Lesueur).
Hyalæa truncata, Lesueur.
Hyalæa uncinata, Hoeninghaus (*non* Rang).
Hyalæa uncinata, Rang.
Hyalæa uncinatiformis, Pfeffer.
Hyalæa vaginellina, Cantraine.

An attentive examination of this superfluity of titles shows that there are amongst them only eight genuine species, all obtained on the Challenger Expedition.

All the other titles are synonyms of these eight species. It is necessary, however, to distinguish :—

1. Thirteen titles referring to the young stages of several of these eight forms :—

Hyalæa complanata, Gegenbaur,	= *Cavolinia tridentata*, Forskål.
Hyalæa depressa, d'Orbigny,	= *Cavolinia inflexa*, Lesueur.
Hyalæa lævigata, d'Orbigny,	= *Cavolinia longirostris*, Lesueur.
Hyalæa rotundata, Boas,	= *Cavolinia globulosa*, Rang.
Hyalæa rugosa, d'Orbigny,	= *Cavolinia gibbosa*, Rang.
Hyalæa truncata, Lesueur,	= *Cavolinia* sp.
Cleodora compressa, Souleyet,	= *Cavolinia trispinosa*, Lesueur.
Cleodora curvata, Souleyet,	= *? Cavolinia uncinata*, Rang.
Cleodora pygmæa, Boas,	= *Cavolinia quadridentata*, Lesueur.
Cleodora trifilis, Troschel,	= *Cavolinia* sp.
Pleuropus hargeri, Verrill,	= *Cavolinia gibbosa*, Rang.
Pleuropus longifilis, Troschel,	= *Cavolinia tridentata*, Forskål.
Pleuropus pellucidus, Eschscholtz,	= *Cavolinia inflexa*, Lesueur.

2. Four titles which may be applied to local varieties of some species :—

Hyalæa affinis, d'Orbigny,	= var. of *Cavolinia tridentata*.
Hyalæa costata, Pfeffer,	= var. of *Cavolinia quadridentata*.
Hyalæa labiata, d'Orbigny,	= var. of *Cavolinia inflexa*.
Hyalæa truncata, Krauss,	= var. of *Cavolinia tridentata*.

3. All the other titles are absolutely synonymous with those of the eight genuine species :—

Hyalæa angulata, Souleyet,	= *Cavolinia longirostris*.
Hyalæa australis, Péron,	= *Cavolinia tridentata*.
Hyalæa chemnitziana, Péron and Lesueur,	
Hyalæa cornea, Lamarck,	
Hyalæa cumingii, Sowerby,	
Hyalæa cuspidata, Delle Chiaje,	= *Cavolinia trispinosa*.
Hyalæa depressa, Bivona,	
Hyalæa ecaudata, Lesueur,	= *Cavolinia longirostris*.
Hyalæa elongata, Lesueur,	= *Cavolinia inflexa*.
Hyalæa femorata, Gould,	= *Cavolinia longirostris*.
Hyalæa fissirostris, Benson,	

Hyalæa flava, d'Orbigny, . .	= *Cavolinia gibbosa.*
Hyalæa forskahlii, Lesueur, . .	= *Cavolinia tridentata.*
Hyalæa gegenbauri, Pfeffer, . .	= *Cavolinia gibbosa.*
Hyalæa imitans, Pfeffer, . .	= *Cavolinia inflexa.*
Hyalæa inermis, Gould, . .	= *Cavolinia quadridentata.*
Hyalæa intermedia, Sowerby, . .	
Hyalæa limbata, d'Orbigny, . .	= *Cavolinia longirostris.*
Hyalæa minuta, Sowerby, . .	= *Cavolinia quadridentata.*
Hyalæa mucronata, Quoy and Gaimard,	= *Cavolinia trispinosa.*
Cavolina natans, Abildgaard, . .	= *Cavolinia tridentata.*
Hyalæa obtusa, Sowerby, . .	= *Cavolinia longirostris.*
Hyalæa papilionacea, Quoy and Gaimard,	= *Cavolinia tridentata.*
Hyalæa peroni, Lesueur, . .	
Cavolina pisum, Mørch, . .	= *Cavolinia globulosa.*
Hyalæa quadrispinosa, d'Orbigny, .	= *Cavolinia quadridentata.*
Hyalæa reeviana, Dunker, . .	= *Cavolinia trispinosa.*
Hyalæa teniobranchea, Péron and Lesueur,	= *Cavolinia tridentata.*
Hyalæa triacantha, Bronn, . .	= *Cavolinia trispinosa.*
Hyalæa uncinata, Hoeninghaus, .	= *Cavolinia inflexa.*
Hyalæa uncinatiformis, Pfeffer, .	= *Cavolinia uncinata.*
Hyalæa vaginellina, Cantraine, .	*Cavolinia inflexa.*

There remain the following eight titles, which represent genuine and distinct species :—

Hyalæa trispinosa, Lesueur.	*Hyalæa gibbosa*, Rang.
Hyalæa quadridentata, Lesueur.	*Anomia tridentata*, Forskål.
Hyalæa longirostris, Lesueur.	*Hyalæa uncinata*, Rang.
Hyalæa globulosa, Rang.	*Hyalæa inflexa*, Lesueur.

From the above list of synonyms of *Cavolinia*, it appears that a number of generic titles have been applied to the present group of Thecosomata.

One may well ask if all these names should be rejected and none retained, or, in other words, if the genus *Cavolinia* is indeed homogeneous and indivisible. It appears to me so to be beyond dispute.

I. *Rheda*, *Hyalæa*, *Archonta*, and *Tricla* are absolutely synonymous with *Cavolinia*, for the simple reason that they refer to the same type, *Anomia tridentata* of Forskål.

II. *Pleuropus* is a designation based on young stages of typical *Cavolinia*, which Boas names "*Hyalæa*, B."[1] They refer to specimens in which the closing apparatus was not yet developed—*Pleuropus pellucidus*, *Pleuropus longifilis*, *Pleuropus hargeri*. Gray

[1] Spolia atlantica, p. 92.

was the first[1] to note the affinities of "*Cleodora curvata*," Souleyet, to this group, but he did not detect what these four forms really represented, and regarded "*Pleuropus*" as a group within the genus *Clio*.

The adults of most of the species of *Pleuropus* are known. As to the others, it is possible to predict, from some of their features, what forms they will probably turn out to be when arrived at sexual maturity. The designation *Pleuropus* is therefore to be abandoned.

III. *Diacria* is a characteristic conchological genus. Gray erected it for the reception of *Cavolinia trispinosa* and two young stages of typical *Cavolinia* forms (group B of Boas), viz., *Hyalæa depressa*, d'Orbigny, and *Hyalæa lævigata*, d'Orbigny, which it would have been more natural to place beside *Pleuropus*. He leaves in the genus *Cavolinia*, *Cavolinia quadridentata*, though it is in all respects the neighbour of *Cavolinia trispinosa*. And, further, he places the same species (*Cavolinia orbignyi*, Rang, fossil) both in the genus *Diacria* and in the genus *Cavolinia*.[2]

On the other hand, the brothers Adams,[3] and others after them, take this title *Diacria* as synonymous with *Pleuropus*,[4] and therefore add to *Cavolinia trispinosa* and to the two forms *Hyalæa depressa* and *Hyalæa lævigata* all the other young forms regarded as independent species. At the same time they agree with Gray in leaving *Cavolinia quadridentata*, separated from *Cavolinia trispinosa*, beside the typical *Cavolinia* forms.[5]

Now, it is certain that if *Cavolinia trispinosa* is to be separated from the other species of *Cavolinia*, *Cavolinia quadridentata* must go with it. The two species are in their structure most closely allied, and form a well-defined subgroup contrasting with the six other species.

And if, in their embryonic shell, in the form of their fins, and in the posterior portion of the foot, they present resemblances to *Clio* (*Cleodora*), they at the same time exhibit the characteristic features of *Cavolinia* in a way that makes separation impossible. They are certainly the most archaic living forms of the genus, but not sufficiently distinct to warrant a separate genus. One may, however, follow Boas in establishing a subsection (*Hyalæa*, A), within the genus *Cavolinia*.

IV. *Orbignyia*, which was only regarded as a subgenus by A. Adams, is based on *Cavolinia inflexa*, which is usually considered as allied to *Clio* (*Cleodora*). There is,

[1] Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 14.

[2] This Catalogue is in other respects full of inaccuracies and carelessness. It would be desirable to re-edit it, especially since the collection of Pteropods in the British Museum is many times richer to-day than it was in 1850.

[3] The Genera of Recent Mollusca, vol. ii. p. 611.

[4] Similarly Pfeffer, Uebersicht der auf S.M. Schiff Gazelle und von Dr. Jagor gesammelten Pteropoden, *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, 1879, p. 236.

[5] Pfeffer (Die Pteropoden des Hamburger Museums, *Abhandl. d. Naturw. Ver. Hamburg*, t. vii.) places *Cavolinia trispinosa* in the subfamily Cleodorinæ, and *Cavolinia quadridentata* in the subfamily Hyaleinæ.

however, no warrant for this opinion. *Cavolinia inflexa* certainly belongs to the second subgeneric section of *Cavolinia*, including the more typical or more highly specialised forms, all, in fact, except *Cavolinia trispinosa* and *Cavolinia quadridentata*. Its elongation and its flattening are not a whit more extraordinary than the expansion and shortening of *Cavolinia globulosa*.

From the above observations this results, that the huge list of species is reduced by analysis to eight, and that, without going to an extreme like d'Orbigny, who united all the Thecosomata of the family Cavoliniidæ into a single genus *Hyalæa*, it may be said that at least the eight species above mentioned form a tolerably homogeneous unit within a single genus.

The eight species thus allowed to exist may be distinguished in the following fashion :—

Key to the Species.

I. Dorsal lip thickened into a pad.
  1. Shell with lateral points, ... *Cavolinia trispinosa.*
  2. Shell without lateral points, ... *Cavolinia quadridentata.*

II. Dorsal lip with a thin margin.
  1. Posterior portion of the ventral lip markedly projecting laterally, . *Cavolinia longirostris.*
  2. Ventral lip not more developed than the dorsal.
    A. Shell without appreciable lateral points.
      a. Shell narrower at the end of the lips than anteriorly.
        α. Ventral surface rounded, ... *Cavolinia globulosa.*
        β. Ventral surface with an anterior transverse keel, . *Cavolinia gibbosa.*
      b. Shell as broad at the end of the lips as anteriorly, . *Cavolinia tridentata.*
    B. Shell with distinct lateral points.
      a. Upper lip flattened posteriorly, ... *Cavolinia uncinata.*
      b. Upper lip directed straight forwards, . . . *Cavolinia inflexa.*

The best series of figures of these eight species is undoubtedly that given by Boas.[1] We shall, therefore, refer to these figures, since it is useless to figure afresh species already sufficiently well known, and hopeless to expect better figures than those of Boas.

*1. *Cavolinia trispinosa* (Lesueur).

1821. *Hyalæa trispinosa*, Lesueur, MS. in de Blainville, Hyale, Dict. d. Sci. Nat., t. xxii. p. 82.
1827. *Hyalæa mucronata*, Quoy et Gaimard, Observations Zoologiques faites à bord de l'Astrolabe, &c., Ann. d. Sci. Nat., sér. 1, t. x. p. 231, pl. viiiB, figs. 1, 2.
1832. *Hyalæa depressa*, Bivona, Descrizione di una nuova specie di Jale, &c., Efemeridi scientifiche e litterarie per la Sicilia, p. 57, pl. i. figs. 4, 5.
1841. *Hyalæa cuspidata*, Delle Chiaje, Descrizione e notomia degli animali senza vertebre del Regno di Napoli, pl. clxxx. figs. 1, 2 (*non* d'Orbigny).

[1] Spolia atlantica, pl. i. figs. 3–11 ; pl. ii. figs. 14–21.

1850. *Diacria trispinosa*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 10.
1850. *Diacria mucronata*, Gray, *Ibid.*, p. 11.
1853. *Hyalæa reeviana*, Dunker, Index Molluscorum, &c., p. 2, pl. i. figs. 17–20.
1858. *Pleuropus trispinosus*, A. and H. Adams, The Genera of Recent Mollusca, vol. ii. p. 611.
1858. *Pleuropus mucronatus*, A. and H. Adams, *Ibid.*, vol. ii. p. 611.

For description and figures, see Boas, Spolia atlantica, p. 94, pl. i. fig. 3; pl. ii. fig. 14.

Habitat.—Atlantic Ocean; from 60° 15′ N. ("Triton" Expedition) to 40° S. (Knocker), both towards the New World and towards the Old; Mediterranean (Delle Chiaje, Cantraine, Costa, Macdonald, &c.).

Indian Ocean; from the Gulf of Bengal (Pfeffer) to 41° S. (Boas), and from Africa (Natal, Madagascar, &c.) to Australia.

Pacific Ocean; western portion, Yellow Sea (British Museum), China Sea (Boas), 13° N., 156° E. ("Vettor Pisani" Expedition); South-west Pacific (Pfeffer), Port Jackson (Angas); North-east Pacific to 30° N. (Knocker).

Challenger Specimens.—I. Living specimens.

Station VIIF., February 2, 1873; off Madeira; lat. 32° 27′ 0″ N., long. 16° 40′ 30″ W.

Station 62, June 18, 1873; Bermuda to Azores; lat. 35° 7′ N., long. 52° 32′ W.

Station 63, June 19, 1873; Bermuda to Azores; lat. 35° 29′ N., long. 50° 53′ W.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 35C, April 22, 1873; off Bermuda; lat. 32° 15′ N., long. 65° 8′ W.; depth, 1950 fathoms; bottom, Globigerina ooze.

Station 70, June 26, 1873; Bermuda to Azores; lat. 38° 25′ N., long. 35° 50′ W.; depth, 1675 fathoms; bottom, Globigerina ooze.

Station 75, July 2, 1873; off Fayal (Azores); lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

Station 76, July 3, 1873; off the Azores; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 164; June 12, 1874; off Sydney; lat. 34° 8′ S., long. 152° 0′ E.; depth, 950 fathoms; bottom, green mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 335, March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom, Pteropod ooze.

*2. *Cavolinia quadridentata* (Lesueur).

1821. *Hyalæa quadridentata*, Lesueur, MS., in Blainville, Hyale, Dict. d. Sci. Nat., t. xxii. p. 81.
1836. *Hyalæa quadrispinosa*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 85.
1850. *Cavolina quadridentata*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 8.
1852. *Hyalæa inermis*, Gould, The Mollusca and Shells of the U.S. Exploring Expedition, pl. li. fig. 604.
1877. *Hyalæa minuta*, Sowerby, in Reeve, Conchologia iconica, t. xx., Pteropoda, fig. 9.
1877. *Hyalæa intermedia*, Sowerby, *Ibid.*, fig. 10.
1879. *Hyalæa costata*, Pfeffer, Uebersicht der auf S.M. Schiff Gazelle und von Dr. Jagor gesammelten Pteropoden, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1879, p. 234.

For description and figures, see Boas, Spolia atlantica, p. 99, pl. i. fig. 4; pl. ii. fig. 15.

Habitat.—Atlantic Ocean; from 34° 30′ N. to 17° 0′ S. (Knocker).

Indian Ocean; from the Gulf of Bengal to the Cape (Pfeffer), from the coasts of Africa (Red Sea, Madagascar, Natal) to Australia. The specimens from the Indian Ocean all belong to the form *costata*.[1]

Pacific Ocean; western portion, Yellow Sea (British Museum), China Sea (Boas), Port Jackson (Angas); eastern portion from 36° N. to 28° S. (Knocker).

Challenger Specimens.—I. Living specimens.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

[1] Pfeffer (Die Pteropoden des Hamburger Museums, *Abhandl. Naturw. Ver. Hamburg*, t. vii. p. 91) also records the form *costata* from the Atlantic.

August—September 1875, Sandwich Islands to Tahiti.

Station 337, March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ S., long. 13° 36′ W.

On April 29, 1876; off St. Vincent (Cape Verde); lat. 18° 8′ N., long. 30° 5′ W.

Station 353, May 3, 1876; St. Vincent to Azores; lat. 26° 21′ N., long. 33° 37′ W.

II. Deposit shells.

Station VIII., February 12, 1873; off Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W., depth, 620 fathoms; bottom, volcanic mud.

Station 3, February 18, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1525 fathoms; bottom, hard ground.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth. 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

*3. *Cavolinia longirostris* (Lesueur).

1821. *Hyalæa longirostris*, Lesueur, MS., in de Blainville, Hyale, Dict. d. Sci. Nat., t. xxii. p. 81.
1821. *Hyalæa ecaudata*, Lesueur, *Ibid.*, p. 82.
1836. *Hyalæa limbata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 101, pl. vi. figs. 11–15.
1852. *Hyalæa angulata*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 152, pl. v. figs. 1–6.
1852. *Hyalæa femorata*, Gould, The Mollusca and Shells of the U.S. Exploring Expedition, pl. li. fig. 603.
1861. *Hyalæa fissirostris*, Benson, Notes on the Pteropodous genus Hyalæa and description of a new species, Ann. and Mag. Nat. Hist., ser. 3, vol. vii. p. 26.
1877. *Hyalæa obtusa*, Sowerby, in Reeve, Conchologia iconica, t. xx., Pteropoda, fig. 8.

For description and figures, see Boas, Spolia atlantica, p. 102, pl. i. fig. 5; pl. ii. fig. 16.

Habitat.—Atlantic Ocean; from 47° N. (Boas) to 40° S. (Knocker), towards both New and Old World.

Indian Ocean; from the Gulf of Bengal to 36° S. (Boas), from the coast of Africa (Red Sea, Arabia, Zanzibar) to Australia.

Pacific Ocean; western portion, Yellow Sea (British Museum), China Sea (Boas), Malay Archipelago, Australia, Tasmania; eastern portion, from 30° N. to 12° S. (Knocker).

Challenger Specimens.—I. Living.

On April 14, 1873; off Bermuda; lat. 32° 10′ N., long. 64° 53′ W.

Station 106, August 25, 1873; St. Vincent to St. Paul's Rocks; lat. 1° 47′ N., long. 24° 26′ W.

Between Stations 162 and 163, April 3, 1874; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 175, August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Station 209, January 22, 1875; Manila to Samboangan; lat. 10° 14′ N., long. 123° 54′ E.

Station 213, February 8, 1875; Samboangan to New Guinea; lat. 5° 47′ N., long. 124° 1′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

August—September 1875; Sandwich Islands to Tahiti.

Station 269, September 2, 1875; Sandwich Islands to Tahiti; lat. 5° 54′ N., long. 147° 2′ W.

Between Stations 292 and 293, October 31, 1875; Tahiti to Valparaiso; lat. 38° 50′ S., long. 108° 6′ W.

Station 338, March 21, 1876; Tristan da Cunha to Ascension Island; lat. 21° 15′ S., long. 14° 2′ W.

Station 345, April 4, 1876; Ascension Island to St. Vincent; lat. 5° 45′ S., long. 14° 25′ W.

Station 349, April 10, 1876; Ascension Island to St. Vincent; lat. 5° 28′ N., long. 14° 38′ W.

Station 352, April 13, 1876; Ascension Island to St. Vincent; lat. 10° 55′ N., long. 17° 46′ W.

Station 353, May 3, 1876; St. Vincent to Azores; lat. 26° 21′ N., long. 33° 37′ W.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

*4. *Cavolinia globulosa* (Rang).

1850. *Cavolina globulosa*, Rang, MS., in Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 8 (without description).

1850. *Cavolina pisum*, Mørch, Catalogus conchyliorum quae reliquit C. P. Kjerulf, p. 32, pl. i. fig. 7.

1852. *Hyalæa globulosa*, Rang, MS., in Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 142, pl. iv. figs. 20–24.

For description and figures, see Boas, Spolia atlantica, p. 107, pl. i. fig. 7; pl. ii. fig. 18.

I retain for this form the specific title *Cavolinia globulosa*, since the figure to which Gray refers in his Catalogue is that of Souleyet's Atlas (Voyage de la Bonite), which appeared (without text) before the catalogue of Mørch, and designates the species in question as "Hyale globuleuse, Rang."

Habitat.—Indian Ocean; from 40° 0′ N. to 34° 30′ S. (Boas), from the coast of Africa, Red Sea (Issel), Zanzibar, Natal (Pfeffer), to Australia.

Pacific Ocean; western portion, from 13° N. ("Vettor Pisani" Expedition), China Sea (Boas), Malay Archipelago; eastern portion, from 2° N. to 12° S. (Knocker).

Souleyet[1] and A. Adams[2] have cited this species as from the Atlantic, but without any precise information. Pfeffer[3] alone notes a single definite locality, lat. 1° S., long. 25° W. I am inclined to suppose that this was some error in labelling, and that *Cavolinia globulosa* does not occur in the Atlantic. It is not recorded either by d'Orbigny, Benson, or Knocker; and Boas, who has examined so much material from the Atlantic, does not note a single specimen as occurring there. And, finally, although the Challenger explored so much of the intertropical Atlantic, and traversed it several

[1] Histoire naturelle des Mollusques Ptéropodes, p. 38.

[2] On the Synonyms and Habitats of Cavolinia, Diacria and Pleuropus, *Ann. and Mag. Nat. Hist.*, ser. 3, vol. iii. p. 45.

[3] Die Pteropoden des Hamburger Museums, *Abhandl. Naturw. Ver. Hamburg*, t. vii. p. 84.

times going and returning, I have not found in the Challenger collection a single Atlantic specimen of *Cavolinia globulosa*.

Challenger Specimens.—Living specimens.

Near Station 213, February 7, 1875; at Samboangan; lat. 5° 59′ N., long. 123° 38′ E.

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.

*5. *Cavolinia gibbosa* (Rang).

1836. *Hyalæa gibbosa*, Rang, MS., in d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 95, pl. v. figs. 16–20.

1836. *Hyalæa flava*, d'Orbigny, *Ibid.*, p. 97, pl. v. figs. 21–25.

1880. *Hyalæa gegenbauri*, Pfeffer, Die Pteropoden der Hamburger Museums, Abhandl. Naturw. Ver. Hamburg, Bd. vii. p. 86, figs. 5, 7.

For description and figures, see Boas, Spolia atlantica, p. 109, pl. i. fig. 6; pl. ii. fig. 17.

Habitat.—Atlantic Ocean; from 43° 10′ N. to 38° 16′ S., from the coasts of America to those of the Old World; Mediterranean, Messina, &c.

Indian Ocean; southern portions, 22° S. (Boas) to 41° S. (Pfeffer), from Africa (Madagascar, Natal) to Australia.

Pacific Ocean; western portion, Yellow Sea (British Museum), China Sea (Boas), 16° N., 165° E. ("Vettor Pisani" Expedition), Port Jackson (Angas), off Tahiti (Knocker); South-east Pacific ("Galathea" Expedition).

Challenger Specimens.—I. Living specimens.

Station VIIF., February 2, 1873; off Madeira; lat. 32° 27′ 0″ N., long. 16° 40′ 30″ W.

Between Stations 162 and 163, April 3, 1873; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 230, April 5, 1875; Admiralty Island to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

Station 249, July 7, 1875; Yokohama to Sandwich Islands; lat. 37° 59′ N., long. 171° 48′ W.

August—September 1875; Sandwich Islands to Tahiti.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 70, June 26, 1873; Bermuda to Azores; lat. 38° 25′ N., long. 35° 50′ W.; depth, 1675 fathoms; bottom, Globigerina ooze.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

*6. *Cavolinia tridentata* (Forskål).

1773. *Anomia tridentata*, Forskål, Descriptiones animalium quae in itinere orientali observavit, p. 124.
1791. *Cavolina natans*, Abildgaard, Nyere Efterretning om det Skaldyr som Forskål har beskrevet under Navnet Anomia tridentata, Skriv. naturhist. Selsk., Bd. i., Heft 2, pl. x.
1801. *Hyalæa cornea*, Lamarck, Système des animaux sans vertèbres, p. 140.
1804. *Hyalæa papilionacea*, Bory de St. Vincent, Voyage dans les quatre principales îles des mers d'Afrique, t. i. p. 137, pl. v. fig. 1.
1810. *Hyale teniobranche*, Péron et Lesueur, Histoire de la famille des Mollusques Ptéropodes, Ann. Mus. Hist. Nat. Paris, t. xv., pl. ii. fig. 13.
1813. *Hyalæa peroni*, Lesueur, Mémoire sur quelques animaux mollusques, &c., Nouv. Bull. Soc. Philom., t. iii. p. 284.
1813. *Hyalæa chemnitziana*, Lesueur, *Ibid.*, p. 284.
1816. *Hyalæa australis*, Péron, Voyage de découvertes aux terres australes, t. i., pl. xxxi. fig. 5 (*sine descriptione*).
1821. *Hyalæa forskahlii*, Lesueur, MS., in de Blainville, Hyale, Dict. d. Sci. Nat., t. xxii. p. 79.
1836. *Hyalæa affinis*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 91, pl. v. figs. 6–10.
1848. *Hyalæa truncata*, Krauss, Südafricanische Mollusken, p. 34, pl. ii. fig. 12 (*non* Lesueur).
1859. *Cavolinia telemus*, A. Adams, On the Synonyms and Habitats of Cavolinia, Diacria and Pleuropus, Ann. and Mag. Nat. Hist., ser. 3, t. iii. p. 44.
1877. *Hyalæa cumingii*, Sowerby, in Reeve, Conchologia iconica, t. xx., Pteropoda, fig. 5.

For description and figures see Boas, Spolia atlantica, p. 115, pl. i. fig. 8; pl. ii. fig. 19.

It is not possible to maintain the specific distinctness of "*Hyalæa affinis*," d'Orbigny, and *Cavolinia tridentata;* the two forms merge into one another (Boas, Spolia atlantica, pl. vi. fig. 100).

Habitat.—Atlantic Ocean; from 39° 53′ N. (Verrill) to the latitude of the Cape of Good Hope, towards both Old and New Worlds; Mediterranean.

Indian Ocean; from 5° N. to about 40° S., from the coast of Africa (Zanzibar) to Australia.

Pacific Ocean; western portion, Yellow Sea (British Museum), China Sea (Boas), Malay Archipelago (Borneo, &c.) (Gray), lat. 13° N., long. 156° E. ("Vettor Pisani" Expedition); South-east Pacific to 37° S. (Knocker).

Challenger Specimens.—I. Living specimens.

Station 241, June 23, 1875; Yokohama to Sandwich Islands; lat. 35° 41′ N., long. 157° 42′ E.

Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

II. Deposit shells.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

*7. *Cavolinia uncinata* (Rang).

1836. *Hyalæa uncinata*, Rang, MS., in d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 93, pl. v. figs. 11–15.

1850. *Cavolina uncinata*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 7.

1880. *Hyalæa uncinatiformis*, Pfeffer, Die Pteropoden des Hamburger Museums, Abhandl. Naturw. Ver. Hamburg, Bd. vii. p. 85.

For description and figures, see Boas, Spolia atlantica, p. 119, pl. i. fig. 10; pl. ii. fig. 20.

The position of a distinct species cannot be allowed to the form *Hyalæa uncinatiformis*, which Pfeffer only distinguishes by certain features of colour and size.

Habitat.—Atlantic Ocean; from 40° 5′ N. (Verrill) to the Cape of Good Hope (British Museum), towards both Old and New Worlds.

Indian Ocean; from the Gulf of Bengal (15° 30′ N.) to 40° S., from Africa, Red Sea (British Museum), south-east of Arabia (Blanford) to near Australia, 111° 40′ E. (Boas).

Pacific Ocean; western portion, Yedo, Yellow Sea (British Museum), China Sea (Boas); eastern portion from 2° 0′ N. to 8° 8′ S. ("Vettor Pisani" Expedition).

Challenger Specimens.—I. Living specimens.

Station 100, August 16, 1873; St. Vincent to St. Paul's Rocks; lat. 7° 1′ N., long. 15° 55′ W.

August—September 1875; Sandwich Islands to Tahiti.

II. Deposit shells.

Station 23, March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

*8. *Cavolinia inflexa* (Lesueur).

1813. *Hyalæa inflexa*, Lesueur, Mémoire sur quelques animaux mollusques, &c., Nouv. Bull. Soc. Philom., t. iii. p. 285, pl. v. fig. 3.
1821. *Hyalæa elongata*, Lesueur, MS., in de Blainville, Hyale, Dict. d. Sci. Nat., t. xxii. p. 82.
1835. *Hyalæa vaginellina*, Cantraine, Bull. Acad. d. Sci. Bruxelles, t. ii. p. 380.
1836. *Hyalæa labiata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 104, pl. vi. figs. 21–25.
1836. *Hyalæa uncinata*, Hoeninghaus, MS., in Philippi, Enumeratio Molluscorum utriusque Siciliæ, p. 101, pl. vi. fig. 18 (*non* Rang).
1880. *Hyalæa imitans*, Pfeffer, Die Pteropoden des Hamburger Museums, Abhandl. Naturw. Ver. Hamburg, Bd. vii. p. 90, pl. vii. fig. 9*a*.

For description and figures, see Boas, Spolia atlantica, p. 123, pl. i. fig. 11; pl. ii. fig. 21.

It is not possible to admit the specific separation of the forms *labiata* and *inflexa*, which are linked to one another by gradual transitional forms (Boas, *loc. cit.*, pl. vi. fig. 98). It is more natural to regard them simply as local varieties, though it must be noted that they are not always respectively confined to distinct localities, but may occur together, as for instance in the Indian Ocean.

Habitat.—Atlantic Ocean; from 41° 35′ N. (Boas) to 40° S. (Knocker), towards both Old and New Worlds; Mediterranean.

Indian Ocean; from the Gulf of Bengal (Pfeffer) to 42° S. (Benson), from the coast of Africa (Zanzibar) to Australia.

Pacific Ocean; western portion, Strait of Corea, China Sea (Boas), Port Jackson (Angas); eastern portion from 13° N. to 42° S.

Challenger Specimens.—I. Living.

Station 142, December 18, 1873; Cape of Good Hope to 46° S.; lat. 35° 4′ S., long. 18° 37′ E.

Station 143, December 19, 1873; Cape of Good Hope to 46° S.; lat. 36° 48′ S., long. 19° 24′ E.

Station 175, August 12, 1874; off the Fiji Islands; lat. 19° 2′ S., long. 177° 10′ E.

Station 181, August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Near Station 230, April 4, 1875; Admiralty Islands to Yokohama; lat. 25° 33′ N., long. 137° 57′ E.

Station 230, April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.

Station 256, July 21, 1875; Yokohama to Sandwich Islands; lat. 30° 22′ N., long. 154° 56′ W.

Station 295, November 5, 1875; Tahiti to Valparaiso; lat. 38° 7′ S., long. 94° 4′ W.

Station 327, March 4, 1876; Rio de Janeiro to Tristan da Cunha; lat. 36° 48′ S., long. 42° 45′ W.

II. Deposit shells.

Station 24, March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Station 33, April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Station 78, July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Station 85, July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Station 120, September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Station 122, September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Station 185, August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Station 323, February 28, 1876; Falkland Islands to Rio de la Plata; lat. 35° 39′ S., long. 50° 47′ W.; depth, 1900 fathoms; bottom, blue mud.

Station 335, March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom, Pteropod ooze.

As we have seen above, there are thirteen specific titles with various generic designations (*Hyalæa*, *Cleodora*, *Pleuropus*) applied to forms which we regard as young stages of some species of *Cavolinia*.

Of these thirteen names it is necessary in the first instance to eliminate (1) *Hyalæa complanata*, Gegenbaur, 1855 (=*Hyalæa longifilis*, Troschel, 1855), and (2) *Pleuropus pellucidus*, Eschscholtz (mistakenly identified by Gray as *Cleodora curvata*, Souleyet), which, in spite of the inadequacy of the figure and description given by Eschscholtz, appears to correspond to *Hyalæa depressa*, d'Orbigny. Since the figures and description given by the latter are more satisfactory, his designation *Hyalæa depressa* is the one adopted.

As to the remaining eleven titles, the last author who has given a systematic account of Pteropods, namely Boas, mentions seven of them which he regards as representing adult forms and distinct species. These are :—

1. *Cleodora compressa*, Souleyet.
2. *Cleodora pygmæa*, Boas.
3. *Cleodora curvata*, Souleyet.
4. *Pleuropus longifilis*, Troschel.
5. *Hyalæa rotundata*, Boas.
6. *Hyalæa lævigata*, d'Orbigny.
7. *Hyalæa depressa*, d'Orbigny.

It is necessary to examine these forms individually.

*1. *Cleodora compressa*, Souleyet.

1850. *Clio depressa*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 14 (*sine descriptione*).
1852. *Cleodora compressa*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 181, pl. vi. figs. 26–32.

From Souleyet's figure it may be inferred that this Pteropod did not exhibit fully developed reproductive organs, and was not therefore an adult.

The form in question ought to be referred to *Cavolinia trispinosa*. To this view, formerly suggested by Pfeffer,[1] Boas objects that in *Cleodora compressa* the mouth is narrower, and that in proportion to the height *Cavolinia trispinosa* is thicker than *Cleodora compressa*. But these comparisons only hold true with a *Cleodora compressa* which is much flattened and a swollen *Cavolinia trispinosa*, and are not sufficient to disprove our opinion, which is based on the following facts :—

1. The embryonic portion, the general form of the shell, and the curvature of the sides are identical in *Cleodora compressa* and *Cavolinia trispinosa*.

2. The fins and the posterior lobe of the foot in *Cleodora compressa* have absolutely the same form as in *Cavolinia trispinosa*.

3. The dorsal surface of the shell of *Cleodora compressa* exhibits three ridges disposed in exactly the same way as in *Cavolinia trispinosa*, and not as in the genus *Clio* (*Cleodora*).

4. As concerns geographical distribution, the two forms are equally cosmopolitan.

Like Souleyet and Boas, the palæontologist Searles Wood[2] has regarded the young fossil *Cavolinia trispinosa* as a distinct species which he has named *Cleodora infundibulum*.

Habitat.—"*Cleodora compressa*" has been noted in the Atlantic Ocean (Souleyet, Rattray) and also in the Pacific Ocean ("Vettor Pisani" Expedition).

[1] Uebersicht der auf S.M. Schiff Gazelle und von Dr. Jagor gesammelten Pteropoden, *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, 1879, p. 237.

[2] Catalogue of Shells found in the Crag, *Ann. and Mag. Nat. Hist.*, ser. 1, vol. ix. p. 459, pl. v. fig. 13, 1842.

Challenger Specimens.—I. Living specimens.

Between Stations 162 and 163, April 3, 1874; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.

Station 181, August 25, 1874; Sydney to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.

Between Stations 247 and 248, July 4, 1875; Yokohama to Sandwich Islands; lat. 36° 42′ N., long. 179° 50′ W.

II. Deposit shells.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

2. *Cleodora pyymæa*, Boas.

1886. *Cleodora pygmæa*, Boas, Spolia atlantica, p. 84, pl. iv. fig. 57.

The close resemblance which this form presents to *Cleodora compressa* shows that it must be the young stage of a species nearly allied to *Cavolinia trispinosa*. But the only species very nearly related to the latter is *Cavolinia quadridentata*.

In the last mentioned, as in *Cavolinia longirostris*, the initial portion of the adult shell is caducous, and is as yet quite unknown, so that *Cleodora pygmæa* fills up a blank.

The three dorsal ribs of *Cleodora pygmæa* correspond absolutely to those of *Cavolinia quadridentata*. The latter is more globular than *Cavolinia trispinosa; Cleodora pygmæa* is also less flattened than *Cleodora compressa*. Finally, the geographical distribution of the two forms is virtually the same; *Cleodora pygmæa* has only been found in localities where *Cavolinia quadridentata* also occurred, in the Indian and Pacific Oceans.

3. *Cleodora curvata*, Souleyet.

1850. *Clio pellucida*, Gray (*pars*), Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 14.

1852. *Cleodora curvata*, Souleyet, Voyage de la Bonite, Zoologie, t. ii. p. 185, pl. vii. figs. 6–10.

Boas, following Souleyet, regards this form as a species of *Clio* (*Cleodora*), and denies that it is only a young stage.[1] Nevertheless it must be noted (1) that the figure of Souleyet shows that the genital organs are scarcely developed, a good proof that the form is not adult, and (2) that the absence of a marked constriction limiting the embryonic shell shows that the form in question is a *Cavolinia* and not a *Clio*. Krohn[2] has already identified it as a young *Cavolinia*.

[1] Spolia atlantica, p. 81.

[2] Beiträge zur Entwickelungsgeschichte der Pteropoden und Heteropoden, p. 43.

As to the species to which this young form should be referred, the slight curvature of the lateral margins leads me to believe that it belongs to a species in which the posterior portion is relatively much developed; and the great breadth of this region in proportion to its length, as well as the absence of dorsal ribs, lead me to regard *Cleodora curvata* as simply a young stage of *Cavolinia uncinata*. It may be further noted that *Cleodora curvata* has only been found in the Atlantic where *Cavolinia uncinata* is most abundant.

To his *Cleodora curvata* Souleyet[1] referred *Hyalæa rugosa*, d'Orbigny. But the latter appears to me to differ considerably in being less thick, in having a proportionately greater length, and in exhibiting a less marked curvature.

Finally, the form described by Huxley under the title *Cleodora curvata* is not a *Clio* at all, since Huxley himself speaks[2] of the "shell fissured laterally," and of the "filiform appendages of the mantle." It is also a *Cavolinia*, but differs from the *Cleodora curvata* of Souleyet, and corresponds to *Hyalæa depressa*, d'Orbigny (see below).

4. *Pleuropus longifilis*, Troschel.

1854. *Pleuropus longifilis*, Troschel, Beiträge zur Kenntniss der Pteropoden, Archiv f. Naturgesch., Jahrg. xx. Bd. i. p. 208, pl. viii. figs. 1, 3.
1855. *Hyalæa complanata*, Gegenbaur, Untersuchungen über Pteropoden und Heteropoden, pp. 40, 211, pl. i. fig. 1.
1886. *Hyalæa longifilis*, Boas, Spolia atlantica, p. 128, pl. iv. figs. 64, 65.

Cantraine has already recognised in this form (which he identified with *Hyalæa lævigata*, d'Orbigny) the young stage of *Cavolinia tridentata*. It is to this species that one must refer the forms described by Troschel and Gegenbaur.

At the suggestion of Dr. Paul Schiemenz, I took occasion at Naples to examine numerous specimens of *Hyalæa tridentata*, among which I could note all the transitions, in size and thickness, between *Pleuropus longifilis* and the typical adult *Cavolinia tridentata*. I also observed that the stage *longifilis* might be abnormally prolonged to a late period, and then developed into specimens of large size and flattened form, with the closing apparatus not yet developed, and with the reproductive system still immature.

5. *Hyalæa rotundata*, Boas.

1886. *Hyalæa rotundata*, Boas, Spolia atlantica, p. 129, pl. iv. figs. 59–61.

This form is certainly the young stage of *Cavolinia globulosa*. That this is so is sufficiently demonstated by the following characters common to the two forms:—

1. Dorso-ventral dilation of the shell;

[1] Histoire naturelle des Mollusques Ptéropodes, p. 52.
[2] On the Morphology of the Cephalous Mollusca, *Phil. Trans.*, 1853, p. 42.

2. The inconsiderable breadth of the posterior portion;
3. The similar disposition of dorsal ribs;
4. The shortness of the rostrum or posterior point.

6. *Hyalæa lævigata*, d'Orbigny.

1836. *Hyalæa levigata*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 110, pl. vii. figs. 15, 19.
1850. *Diacria lævigata*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 11.
1858. *Pleuropus lævigatus*, A. and H. Adams, The Genera of Recent Mollusca, vol. ii. p. 611.

I refer this form to *Cavolinia longirostris*, with which it appears to have most affinity:—

1. In the horizontal direction of the posterior margins;
2. In the way the ventral lip extends posteriorly beyond the dorsal;
3. In the two inconspicuous dorsal grooves;
4. In the curvature of the posterior portion (in *Cavolinia longirostris* the initial portion of the shell is always broken off, but even the direction of the truncature shows that the portion which has disappeared would have been much recurved dorsally). It is of course not to be imagined that "*Hyalæa lævigata*" is the caducous portion of *Cavolinia longirostris*, to which only its posterior recurved portion corresponds.

The geographical distribution of the two forms is the same. *Cavolinia longirostris* is abundant in localities where *Hyalæa lævigata* has been found.

*7. *Hyalæa depressa*, d'Orbigny.

1825. *Pleuropus pellucidus*, Eschscholtz, Bericht über die zoologische Ausbeute während der Reise von Cronstadt bis St. Peter und Paul, Oken, Isis, 1825, p. 735, pl. v. fig. 2 (*male*).
1836. *Hyalæa depressa*, d'Orbigny, Voyage dans l'Amérique méridionale, t. v. p. 110, pl. vii. figs. 11–14.
1850. *Clio pellucida*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 14.
1850. *Diacria depressa*, Gray, *Ibid.*, p. 11.
1853. *Cleodora curvata*, Huxley, On the Morphology of the Cephalous Mollusca, &c., Phil. Trans., 1853, p. 42, pl. iv. figs. 4, 5.
1858. *Pleuropus depressus*, A. and H. Adams, The Genera of Recent Mollusca, vol. ii. p. 611.

Souleyet[1] has referred *Pleuropus pellucidus* to *Clio cuspidata*, and Gray to "*Cleodora curvata*," Souleyet. These identifications appear to me erroneous, as in my opinion *Pleuropus pellucidus* corresponds to *Hyalæa depressa*. But as the description and figure given by Eschscholtz are equally bad, it is better to ignore entirely the title which he has bestowed.

[1] Histoire naturelle des Mollusques Ptéropodes, p. 48.

On the other hand, Souleyet[1] expresses his belief that *Hyalæa depressa* is only a young state of *Cavolinia inflexa*. This opinion[2] seems to me correct. In fact my examination of a specimen of *Hyalæa depressa* showed me that this form was sexually immature, with incompletely developed accessory genital glands, while on the other hand the slight thickness of the shell, the length, the comparative narrowness, and the curvature of the posterior portion, are in favour of Souleyet's theory; and besides, *Hyalæa depressa* has been found almost always where *Cavolinia inflexa* occurred in abundance, namely, in the Pacific Ocean, 20° S., 87° W. (d'Orbigny), 5° N., 115′ W.; Callao to Honolulu ("Vettor Pisani" Expedition, June 9, 1884); in the Indian Ocean, Colombo to Aden ("Vettor Pisani" Expedition, March 10, 1885); and, finally, in the Atlantic (Challenger Expedition).

Challenger Specimens.—I. Living specimens.

Station 216A, February 16, 1875; Samboangan to New Guinea; lat. 2° 46′ N., long. 134° 11′ E.

On May 4, 1875; at Yokohama.

Station 350, April 11, 1876; Ascension Island to St. Vincent; lat. 10° 55′ N., long. 17° 46′ W.

II. Deposit shells.

Station 219, March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

There remain four other names, which are not mentioned by Boas, viz.,

Hyalæa truncata, Lesueur.[3]
Hyalæa rugosa, d'Orbigny[4] (*Balantium rugosum*, Gray).
Cleodora trifilis, Troschel.[5]
Pleuropus hargeri, Verrill.[6]

Souleyet[7] refers the two former to his "*Cleodora curvata*." This appears to me inaccurate. *Hyalæa rugosa* (which has been found in the South-east Pacific) differs from "*Cleodora curvata*" in being less thick, in being longer in proportion to breadth, and in having a less marked curvature.

I regard this form and *Pleuropus hargeri* (North-west Atlantic) as two successive stages of *Cavolinia gibbosa*. The length, the slight thickness, the moderate curvature of the initial point in both forms, as well as the slight divergence of the lateral margins, support this opinion.

[1] Histoire naturelle des Mollusques Ptéropodes, p. 44.
[2] Shared by Weinkauff (Die Conchylien des Mittelmeeres, t. ii. p. 424).
[3] In de Blainville, Hyale, Dict. d. Sci. Nat., t. xxii. p. 82.
[4] Voyage dans l'Amérique méridionale, t. v. p. 118, pl. viii. figs. 12–14.
[5] Beiträge zur Kenntniss der Pteropoden, *Archiv f. Naturgesch.*, 1854, Bd. i. p. 205, pl. viii. fig. 4.
[6] Catalogue of the Mollusca added to the Fauna of New England during the past ten years, *Trans. Connect. Acad.*, vol. v. p. 555.
[7] Histoire naturelle des Mollusques Ptéropodes, p. 52.

As to "*Cleodora trifilis*," it is difficult to determine to what adult form this young stage should be referred. But the absence of any well-marked constriction separating the embryonic shell, and the presence of three lateral appendages on each side of the mantle, show clearly that we have here to do with a *Cavolinia* and not with a *Clio* (*Cleodora*). But according to Troschel the posterior portion of the shell is not curved, while all the species of *Cavolinia* (except the group *Cavolinia trispinosa* and *Cavolinia quadridentata*, where the embryonic shell is markedly separate) exhibit a dorsal curvature of the initial portion. The position of "*Cleodora trifilis*" must therefore remain uncertain.

Family III. Cymbuliidæ.

1841. *Cymbulidæ*, Cantraine, Malacologie méditerranéene et littorale, Mém. Acad. Sci. Bruxelles, t. xiii. p. 33.
Hyalæidæ, pars, Auctorum.
1885. *Alata*, Wagner, Die Wirbellosen des weissen Meeres, Bd. i. p. 119.

Characters.—"Shell" straight, bilaterally symmetrical, so-called cartilaginous, quite enveloped in the mantle. The animal cannot completely retire within it. The animal has a ventral pallial cavity, and the fins form a broad disc, on the dorsal margin of which the cephalic portion is laid back.

Description.—The "shell" of the adult Cymbuliidæ is considerably elongated in a dorso-ventral direction. It is somewhat hollowed out in the form of a boot or slipper, and is more or less broadly open ventrally. It is not homologous with the calcareous shell of other Thecosomata. In the Cymbuliidæ the homologue of the latter falls off at the close of the larval life. As to the cartilaginous "deutoconch" or "pseudoconch," it is the result of thickening of the integument. Nor is it the only illustration of such a structure among the Thecosomata, for in *Cavolinia tridentata*, on the anterior portion of the dorsal lip of the shell, there is a small covering portion with the same structure as the "shell" of the Cymbuliidæ, and similarly produced by the mantle, the prolongations of which may cover a considerable portion of the shell.

The deutoconch of the Cymbuliidæ, which is only covered by a delicate epithelial layer, is very readily lost,[1] as the result of which the members of this family have often been described as naked.

The animal has its visceral portion relatively little developed, and the foot, modified as a fin, greatly predominates. The cephalic portion is distinct; it extends beyond the dorsal margin of the fin, and is reflected on the anterior portion of the latter, forming a sort of proboscis, more or less elongated, sometimes remaining free (*Gleba* and *Cymbuliopsis*) or fixed to the surface of the fin. The lips do not consist as in the typical Thecosomata (Cavoliniidæ) of two dorso-ventral folds, united dorsally above the mouth, and continued on divergently to the ventral margin of the fins without re-uniting

[1] By "*Cymbulia*" *ovata*, Quoy and Gaimard, *Gleba cordata*, Forskål, &c.

ventrally below the mouth; on the contrary they completely surround the mouth, dorsally and ventrally, without being in any way continued on to the fin. Their disposition recalls, especially in the young specimens, that of *Peraclis*.

The two tentacles are absolutely symmetrical, and the right one is not enclosed in a sheath. The penis is situated on the dorsal surface of the head, in the median line in the adult.

The orientation of these animals is given but unsatisfactorily in malacological descriptive works. This is especially true, as we shall see, of *Cymbulia*, and is due to the marked external difference between the Cymbuliidæ and the other Thecosomata.

From a systematic point of view the family is yet more unsatisfactorily known than even the Limacinidæ. For the shell of the adult Cymbuliidæ not only has a morphological import different from that of the other Thecosomata, but is also different structurally, and does not admit of being preserved in the dry state. In consequence of which it has received but little attention from the "dry-skin philosophers"; and as in the general systematic treatment of Mollusca, at least as regards genera and species, the conchologists have the upper hand, the result is that our knowledge of the systematic relations of this group is in a rudimentary state, and that the information we possess of the animals is of a most restricted and incomplete character.

It is very unfortunate that the materials as yet at command have not enabled me to make any great progress. I can only interpret more clearly the known facts, correct certain errors, and complete or elucidate certain observations.

The generic names hitherto applied to the forms in this family are four in number:— *Corolla*, *Cymbulia*, *Gleba*, and *Tiedemannia*. Of these four names, two, namely *Corolla* and *Tiedemannia*, are, as we shall afterwards see, synonymous with *Gleba*. There only remain *Cymbulia* and *Gleba* to take account of.

But to distribute the different species of Cymbuliidæ between these two genera, and to determine their respective boundaries, is no easy task, especially with the slight utilisable material at command. This difficulty is increased by the fact that we have shells without animals and animals without shells, and that the latter have been described as naked, while in reality all the adult members of this family possess the so-called "cartilaginous" pseudoconch.

If we survey the different specific titles given to forms referred to the Cymbuliidæ, we find, in addition to the four names of genera, the following seventeen names of species:—

Cymbulia calceola, Verrill.
Cymbulia cirroptera, Gegenbaur.
Cymbulia norfolkensis, Quoy and Gaimard.
Cymbulia ovata, Quoy and Gaimard.
Cymbulia peroni, de Blainville.
Cymbulia proboscidea, Gray.
Cymbulia punctata, Quoy and Gaimard.

Cymbulia quadripunctata, Gegenbaur.	*Tiedemannia creniptera*, Krohn.
Cymbulia radiata, Quoy and Gaimard.	*Tiedemannia napolitana*, Delle Chiaje.
Tiedemannia charybdis, Troschel.	*Tiedemannia scyllæ*, Troschel.
Tiedemannia chrysosticta, Krohn.	*Corolla spectabilis*, Dall.

Gleba cordata, Forskål.

But it is necessary to note that among the above there are :—

1. One title applied to a Gymnosomatous form, *Cymbulia norfolkensis*, Quoy and Gaimard, which is a *Halopsyche* (see Report on Gymnosomata).[1]

2. Numerous titles applied to young stages, which have been regarded as distinct forms (after the embryonic development there are yet notable external differences between the very young Cymbuliidæ and the adult forms) :—

Cymbulia punctata, Quoy and Gaimard,	*Tiedemannia scylla*, Troschel,
Cymbulia radiata, Quoy and Gaimard,	*Tiedemannia charybdis*, Troschel,

are certainly young forms of *Gleba*. So too the *Cymbulia cirroptera* of Gegenbaur is in all probability only the young form of this genus *Gleba*, nor can I regard *Cymbulia quadripunctata*, Gegenbaur, as an adult individual.

3. Three titles are synonyms for other species :—

Cymbulia proboscidea, Gray = *Cymbulia peroni*, de Blainville.
Tiedemannia napolitana, Delle Chiaje,
Tiedemannia creniptera, Krohn, } = *Gleba cordata*, Forskål.

There thus remain six titles :—

Cymbulia calceola, Verrill.	*Tiedemannia chrysosticta*, Krohn.
Cymbulia peroni, de Blainville.	*Corolla spectabilis*, Dall.
Cymbulia ovata, Quoy and Gaimard.	*Gleba cordata*, Forskål.

It is necessary now to note that of these six species there are only two which are really well known. These are *Cymbulia peroni* and *Gleba cordata*, both from the Mediterranean. The others are very imperfectly known, as for instance *Cymbulia ovata* and *Gleba spectabilis*. The latter and *Tiedemannia chrysosticta* have not yet been figured; of *Cymbulia ovata* and *Gleba spectabilis* I have been able to examine specimens, but these were unfortunately in an insufficient state of preservation.

In utilising the information which we possess in regard to these six forms, we have to face the difficulty which I have mentioned above, the difficulty namely of distributing the different forms between the two genera *Gleba* and *Cymbulia*, or, in other words, of establishing the exact limits and differential characteristics of the two genera.

[1] Zool. Chall. Exp., pt. lviii. p. 55.

If we restrict our attention to *Cymbulia peroni* and *Gleba cordata*, the question s indeed simplified. We see then, in *Gleba*, a free elongated proboscis, a fin with ontinuous margin, without ventral lobe, and a "shell" of considerable delicacy, almost without cavity, and with a nearly smooth surface; while in *Cymbulia*, on the contrary, we fi nd a fin with a ventral lobe, a short proboscis, not at all free, and a thick "shell" with a marked cavity and with a spiny surface. Thus we understand how the differentiating characters of the two genera are given with so much definiteness by the authors[1] who establish their generic diagnosis according to these two forms.

But these two forms (*Cymbulia peroni* and *Gleba cordata*) are precisely the two extremes of the series of Cymbuliidæ, and if we turn from these to the four other forms already enumerated, we find:—

1. In *Tiedemannia chrysosticta* and in *Corolla spectabilis*, which belong to the genus *Gleba*, the proboscis is very short, as is also the case in a form from the Atlantic, figured by Boas (pl. iii. fig. 31, Spolia atlantica).

2. In "*Cymbulia*" *ovata* and in "*Cymbulia*" *calceola*, the fin presents a continuous margin and no ventral lobe. In these respects they thus resemble *Gleba*, while the proboscis, which is indeed short, is free, and resembles that of *Tiedemannia chrysosticta* and *Corolla spectabilis*. The "shell," on the other hand, is altogether different, both from that of *Cymbulia* and that of *Gleba*, for it is rather thin, with a tuberculated surface, and with a very large cavity.

J. D. Macdonald also figures[2] a *Cymbulia* from the Indian Ocean without a ventral lobe to the fin. I have unfortunately been unable to see his specimens, but I entertain much doubt as to the form of this fin, since the "shell" of this form is very like that of *Cymbulia peroni* from the Mediterranean, and the latter, like one of the Challenger forms from the Western Pacific, exhibits a well-developed ventral lobe on the fin.

On the other hand, "*Cymbulia*" *calceola* and "*Cymbulia*" *ovata*, which are entirely destitute of the above lobe, agreeing in this particular with the *Cymbulia* of Macdonald, possess a shell quite different from *Cymbulia peroni*, the *Cymbulia* figured by Macdonald, and *Cymbulia parvidentata*, n. sp., from New Zealand. This shell is not pointed dorsally, and does not exhibit ventrally the special truncation seen in the three forms above mentioned. It has a distinct slipper-like form, with thin walls, with a deep cavity, and without spines along its aperture.

From the above it must be evident that the genera *Cymbulia* and *Gleba* are nearer one another than might be inferred from the contrast between *Cymbulia peroni* and *Gleba cordata*. It also becomes obvious that it is impossible to refer to these two genera alone all the forms which have been referred to the family Cymbuliidæ. "*Cymbulia*" *ovata* and "*Cymbulia*" *calceola* cannot be placed within either genus,

[1] See Gegenbaur, Untersuchungen über Pteropoden und Heteropoden, p. 40, note 1.

[2] On the General Characters of the genus Cymbulia, *Proc. Roy. Soc.*, vol. xxxviii. p. 252.

and demand the establishment of a new division which I propose to call *Cymbuliopsis.*

The only way of distributing the different species of Cymbuliidæ seems to me to be as follows :—

1. *Gleba;* proboscis free, fin with a continuous margin, shell flattened, with almost no cavity.
2. *Cymbuliopsis;* proboscis free, fin with a continuous margin, shell in form of a slipper, with a very large cavity.
3. *Cymbulia;* proboscis fixed throughout its entire length, fin with a ventral lobe, shell thick, with a reduced cavity.

The genus *Cymbulia* will include (1) *Cymbulia peroni*, de Blainville, (2) *Cymbulia parvidentata*, n. sp., (3) a form of which a specimen without shell was collected by the Challenger in the Western Pacific Ocean, and very probably also the *Cymbulia* of the Indian Ocean figured by Macdonald.

The genus *Cymbuliopsis* will include (1) *Cymbulia ovata*, Quoy and Gaimard, and (2) *Cymbulia calceola*, Verrill.

Finally, the genus *Gleba* will include (1) *Gleba cordata*, Forskål, (2) *Tiedemannia chrysosticta*, Krohn, and (3) *Corolla spectabilis*, Dall.

Cymbulia,[1] Péron and Lesueur.

1810. *Cymbulia*, Péron et Lesueur, Histoire de la famille des Mollusques Ptéropodes, Ann. Mus. Hist. Nat. Paris, t. xv. p. 66.

Characters and Description.—The "*shell*" or deutoconch, described as cartilaginous or gelatinous, is elongated in a dorso-ventral direction, and has a moderately elongated cavity and a pointed dorsal extremity. The external surface is covered with tubercles arranged in rows parallel to the main axis, the dorsal extremity is always dilated and projects more or less markedly.

The animal has a natatory disc of considerable breadth, and a ventral lobe on the foot. The cephalic portion is reflected on the dorsal margin of the fin, but is fixed throughout its length, and constricted towards its distal extremity. A radula and jaws.[2]

The orientation of *Cymbulia*, and indeed of all the species of Cymbuliidæ, has been generally misunderstood, especially in general works on Mollusca. First of all, in regard to the position of the animal within the shell there has been a difference of opinion somewhat analogous to that ancient discussion in regard to *Nautilus.*

[1] Corruption of *Cymbula*, slipper.

[2] Woodward, in his Manual of the Mollusca (1856), notes two stomachal plates, while in 1839 van Beneden recognised four, and this any one might verify. Nevertheless the manuals of conchology have continued to copy from Woodward, and mention only two plates, as for example in the Structural and Systematic Conchology of Tryon—a compilation destitute of scientific value.

De Blainville criticises the figure of Péron and Lesueur,[1] and affirms that the animal is turned in the wrong direction in relation to the shell. He figures *Cymbulia* with the animal turned in the opposite direction.[2] But his characteristic love of criticism is in this instance at fault, for it is in his figure that the animal is inverted. The uncertainty as to the orientation of the animal in relation to the shell is doubtless due to the readiness with which shell and animal are separated, and the difficulty of preserving the specimens in their natural position. The same reason has led some authors to assert in regard to *Cymbulia* what has been affirmed of the female *Argonauta*, that the shell was not produced by the animal at all.[3]

In regard to the position of anterior and posterior extremities of the shell and of the animal, Woodward's Manual of the Mollusca, which has been followed by all subsequent treatises, represents the pointed extremity of the shell of *Cymbulia peroni* as anterior, and the truncated end as posterior. Macdonald,[4] however, does not accept this statement, but gives a diametrically opposite interpretation. According to him the truncated extremity is anterior. Both these conclusions are inaccurate.

The source of error lies in the external differences between the shell of Cymbuliidæ and those of Cavoliniidæ, and in the great elongation of the dorso-ventral axis, which has led to its being regarded as antero-posterior.

To elucidate the true orientation of the shell, it is necessary to make an examination of the animal itself. An investigation of the latter shows that the pallial cavity, which in all the Thecosomata (except the Limacinidæ) opens ventrally, in consequence of a secondary process to be explained in the Anatomical Report, opens in *Cymbulia peroni* in the direction of the truncated extremity of the shell. This extremity ought therefore to be considered as ventral. On the other hand, the dorsal portion of the animal, as determined by the position of the tentacles, is situated on the side of the pointed end. This extremity is therefore to be regarded as dorsal, and the antero-posterior axis of the shell is the short axis at right angles to the surface of the fins.

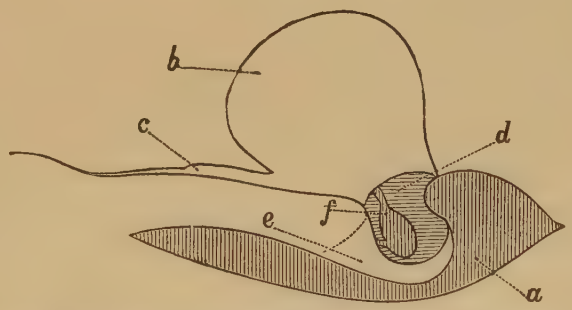

FIG. 1.—Sagittal section of a *Cymbulia*; *a*, shell; *b*, fin; *c*, ventral lobe of the foot and its whip-like process; *d*, visceral mass; *e*, pallial cavity; *f*, alimentary canal.

Among the forms referred to this genus only one is well known. There is also a second new form of which unfortunately only the shell is known.

[1] Histoire de la famille des Mollusques Ptéropodes, *Ann. Mus. Hist. Nat. Paris*, t. xv. pl. iii. fig. 10.
[2] Manuel de Malacologie, pl. xliii. fig. 3.
[3] Cantraine, Malacologie méditerranéenne et littorale, *Mém. Acad. Sci. Bruxelles*, t. xiii. p. 35.
[4] On the General Characters of the Genus Cymbulia, *Proc. Roy. Soc.*, vol. xxxviii. p. 251.

I have already mentioned that I have much doubt in regard to the form of the fin in the "*Cymbulia*" from the Indian Ocean, as figured by Macdonald. I am of opinion that this species (if distinct from the Mediterranean *Cymbulia peroni*) belongs to the above genus and bears a ventral lobe on the fin. This seems the more likely since *Cymbulia peroni*, in which the ventral lobe is indubitably present, has also been figured by Deshayes[1] as if it were really absent.

Finally, a fourth form of this genus is represented by a specimen without a shell, collected by the Challenger in the Pacific Ocean. It is possible that this form corresponds to *Cymbulia parvidentata*, n. sp., from New Zealand, of which only the shell is known. This cannot, however, be affirmed as fact. The single specimen of the above-mentioned form is stained and mounted in balsam; it is therefore impossible to give any satisfactory description.

The above facts comprise all we know about the Cymbuliidæ, from a systematic point of view. Abstracting the two forms last mentioned, we may distinguish the other two as follows:—

Key to the Species.

1. Shell with a somewhat broad cavity, with strong spines, chiefly along the aperture, ... *Cymbulia peroni.*
2. Shell with a very narrow cavity, with small and uniform spines, . . *Cymbulia parvidentata.*

1. *Cymbulia peroni*, de Blainville.

1818. *Cymbulia peronii*, de Blainville, Dict. d. Sci. Nat., t. xii. p. 333, pl. lix. fig. *a*.
1850. *Cymbulia proboscidea*, Gray, Catalogue of the Mollusca in the Collection of the British Museum, pt. ii., Pteropoda, p. 25 (*non* Krohn, 1844).

This form is sufficiently well known to dispense with a fresh description. I shall restrict myself to distinguishing it from the next species. The dorsal portion of the shell is swollen and short; the extremity is markedly obtuse; the shell does not exhibit any constriction at the middle of its length; the two lines of tubercles, which end in the two ventral points, are distinctly parallel, and the spines which bound the aperture are larger on the right than on the left.

Among the numerous figures of this species, many are poor, and few satisfactory. That of Boas[2] has been based on a small specimen, preserved in alcohol. The best idea of the living animal is obtained from the figure given by Delle Chiaje.[3]

Habitat.—Mediterranean; Nice, Villefranche, Civita Vecchia, Naples, Messina.

[1] Traité élémentaire de Conchyliologie, pl. cii. fig. 3.
[2] Spolia atlantica, pl. iv. fig. 30.
[3] Descrizione et notomia degli animali senza vertebre del Regno di Napoli, pl. xxxii. fig. 1.

Krohn[1] collected in the Atlantic, off Tenerife, some larval forms of *Cymbulia*, but as the adults were not observed, it is not known whether they belong to the present species or not.

Observations.—I. *Cymbulia quadripunctata*, Gegenbaur, is not an adult form. I have no hesitation in describing it as a young *Cymbulia peroni*, for I have observed at Naples, among young forms of *Cymbulia* entirely like one another, an individual with purple spots on the fins as in Gegenbaur's species; but the presence of these spots is no specific distinction.

II. It is uncertain whether the *Cymbulia* of the Indian Ocean figured by Macdonald is identical with *Cymbulia peroni*. It is distinguished especially by the much longer dorsal portion and by the straight contours.

2. *Cymbulia parvidentata*, n. sp. (Pl. II. figs. 12, 13).

Characters and Description.—*Shell* slender, proportionally narrower and more elongated than the above, and exhibiting a constriction towards the middle of its length, the dorsal portion long and pointed, the spines on the surface of small size and very uniform even on the borders of the aperture, where they are very large and distinct in *Cymbulia peroni*. The two rows of spines which end in the ventral points exhibit at their middle a re-entrant angle corresponding to the constriction of the shell. The cavity of the latter is very narrow and of little depth.

Animal unknown.

Dimensions.—Smaller than the preceding species, the shell 3·5 cm. in length.

Habitat.—Cook Strait, New Zealand (the type specimen is in the British Museum).

*3. *Cymbulia* sp. (?).

A specimen of a *Cymbulia*, without its shell, with the fin as in *Cymbulia peroni*, that is to say, bearing a ventral lobe ending in a whip. As the specimen was stained and mounted in balsam, it is difficult to give any detailed description. I shall not bestow on it any specific title. It is possible that it belongs to the above species, in which the animal is still unknown, both forms occurring in the Pacific Ocean.

Challenger Specimen.—Station 254, July 17, 1875; Yokohama to Sandwich Islands; lat. 35° 13′ N., long. 154° 43′ W.

Embryonic shells of *Cymbulia* (Pl. II. fig. 14) have been collected at the following locality:—

Station 216A, February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 34° 11′ E.

[1] Beiträge zur Entwickelungsgeschichte der Pteropoden und Heteropoden, p. 19.

Cymbuliopsis,[1] n. gen.

Characters and Description.—"Shell" in form of a slipper, with thin walls, and a very large cavity extending to the dorsal extremity. The latter is rounded, while the ventral extremity, which is very delicate, ends in a level margin. The whole external surface is covered with small, uniform tubercles; the aperture is of considerable size; its margins do not bear spines.

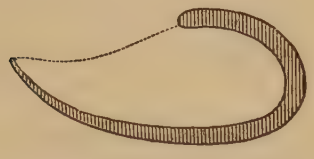

Fig. 2.—Sagittal section of the shell of *Cymbuliopsis*, in which the dotted line indicates the aperture.

The animal has a fin without ventral lobe, that is to say, with a continuous ventral margin. The proboscis is free throughout its entire length, but is short and broad. No radula or jaws.

Two species described as *Cymbulia* ought to be referred to this genus—*Cymbulia ovata*, Quoy and Gaimard, and *Cymbulia calceola*, Verrill.

Key to the Species.

1. Shell somewhat constricted at the two ends, aperture shorter than the half-length of the shell, ... *Cymbuliopsis ovata.*
2. Shell rather broad at the two ends, aperture longer than the half-length of the shell, ... *Cymbuliopsis calceola.*

1. *Cymbuliopsis ovata* (Quoy and Gaimard) (Pl. II. figs. 15, 16).

1832. *Cymbulia ovata*, Quoy et Gaimard, Voyage de découvertes de l'Astrolabe, Zoologie, t. ii. p. 373, pl. xxvii. figs. 25–30.
1852. *Cymbulia ovularis*, Rang, Histoire naturelle des Mollusques Ptéropodes, pl. xi. figs. 1–6.

Characters and Description.—Shell ovoid, very broad in the middle region, constricted towards the ends, and especially at the ventral extremity, where it is very little thickened. The external surface is covered with small uniform tubercles, regularly distributed, but somewhat distant. The aperture is very nearly as long as the half-length of the shell.

The animal exhibits all the characters of the genus. The proboscis is somewhat broad towards the extremity. Quoy and Gaimard have mistaken the proboscis for the ventral lobe of the fin of *Cymbulia*. The fins which they note as being separated by a hollow, have a continuous margin like *Cymbuliopsis calceola* and *Gleba*.

Dimensions.—The shell measures from 2 to 3 cm. in length.

Habitat.—Amboina (Quoy and Gaimard). The British Museum collection includes several specimens, but without note of locality.

[1] *Cymbulia*, and ὄψις, appearance.

2. *Cymbuliopsis calceola* (Verrill).

1880. *Cymbulia calceola*, Verrill, Notice of the remarkable Marine Fauna occupying the outer banks off the southern coasts of New England, Amer. Journ. Sci. and Arts, ser. 3, vol. xx. p. 394.

1882. *Cymbulia calceolus*, Verrill, Catalogue of the Marine Mollusca added to the fauna of New England during the past ten years, Trans. Connect. Acad., vol. v. p. 553, pl. lviii. fig. 33.

Characters and Description (after Verrill).—*Shell* ovoid, rounded, but of considerable breadth at the two extremities. The external surface is covered with numerous rounded tubercles; the aperture is larger than the half-length of the shell; the ventral margin is almost straight.

Animal of a pale yellow colour, with a very large fin, exhibiting an entire and continuous margin.

Dimensions.—Maximum length of shell 4 cm., transverse diameter of the fin 67 mm.

Habitat.—Eastern coast of North America, about lat. 40° N., long. 70° W. (Verrill).

Observations.—This species has been somewhat better described than the preceding *Cymbuliopsis ovata*, with which it seems to have close affinities. Verrill does not mention whether the proboscis is free along its entire length, but this seems to me very probable since it is so in the preceding species. I cannot, however, admit the suggestion of Boas,[1] who regards this species as a *Gleba* (*Tiedemannia*). To this view the form of the shell is altogether opposed. On the other hand, it is possible that the "*Tiedemannia*" with short proboscis, from the equatorial Atlantic (lat. 2° N., long. 26° W.), which Boas has figured,[2] may be identical with Verrill's species of *Cymbuliopsis*. In spite of certain points of resemblance, the suggestion cannot, however, be made with any confidence, since the shell was absent in the specimen described by Boas. It is equally difficult to interpret other forms of Cymbuliidæ which have been found without their shells. Thus we have *Argivora parva*, Lesueur,[3] from la Martinique (Antilles), described as a naked *Cymbulia*, but admitting of no certain decision.

Gleba,[4] Forskål.

1774. *Gleba*, Forskål, Icones rerum naturalium, pl. xliii. fig. D.

1839. *Tiedemannia*, Delle Chiaje, in van Beneden's Exercices Zootomiques, Mém. Acad. Sci. Bruxelles, t. xxv. p. 23.

Characters and Description.—*Shell* somewhat short, broad, much flattened, rounded at the dorsal extremity, slightly truncated at the ventral. The cavity is almost absent, so

[1] Spolia atlantica, p. 142.

[2] *Ibid.*, pl. iii. figs. 31, 32.

[3] In de Blainville, Manuel de Conchyliologie, p. 655.

[4] *Gleba*, earth-clod.

that the aperture occupies the entire length of the shell. There is a second nuchal portion of the same nature (at least in *Gleba cordata* = *Tiedemannia neapolitana*).

Animal with a cephalic portion ("trompe") more or less elongated, free over its entire length, situated in front of the fin, and enlarged towards its distal extremity. Near this the fin forms a disc, with continuous margin, and without ventral lobe. No radula or jaws.

FIG. 3.—Sagittal section of the shell of *Gleba;* the dotted line indicates the aperture.

The shell of this genus was observed for the first time by Krohn[1] in *Gleba cordata.* It falls off so readily that specimens without their shells are very frequent, and it is difficult to preserve a specimen intact, with the shell in its natural position. This fact explains how the older authorities (Forskål, van Beneden, Delle Chiaje, &c.) did not observe the shell of *Gleba cordata,* and have even described other species as naked.

There is certain evidence of the presence of this genus in almost all the seas. Unfortunately, a large proportion of the available material consists of incomplete or ill-preserved specimens, while many of the forms noted are only known in their young and immature stages.

The number of species known in their adult state is really only three:—*Gleba cordata,* Forskål, "*Tiedemannia*" *chrysosticta,* Gegenbaur, "*Corolla*" *spectabilis,* Dall, and of these the last two have not yet been figured.

KEY TO THE SPECIES.

I. Proboscis long, ...	*Gleba cordata.*
II. Proboscis short.	
1. Gilded spots on the fin, ...	*Gleba chrysosticta.*
2. Fins of an uniform colour, ...	*Gleba spectabilis.*

1. *Gleba cordata,* Forskål.

1774. *Gleba cordata,* Forskål, Icones rerum naturalium, pl. xliii. fig. D.
1839. *Tiedemannia napolitana,* Delle Chiaje, in van Beneden, Exercices zootomiques, Mém. Acad. Sci. Bruxelles, t. xii. p. 22, pl. ii. fig. 1.
1844. *Cymbulia proboscidea,* Krohn, Ueber eine neue Pteropoden Art, Archiv f. Naturgesch., 1844, Bd. i. p. 327.
1844. *Tiedemannia creniptera,* Krohn, *Ibid.,* pl. ix. fig. A.
1847. *Tiedemannia neapolitana,* Krohn, Nachträge zu den Aufsätzen über Tiedemannia, &c., Archiv f. Naturgesch., 1837, Bd. i. pl. ii. figs. B, C.

This species has been generally but poorly figured. The best drawings are those given by Krohn (*loc. cit.*) and by Gegenbaur,[2] which supplement each other,

[1] Nachträge zu den Aufsätzen über Tiedemannia, &c., *Archiv f. Naturgesch.,* 1847, Bd. i. pl. ii. figs. B, C.
[2] Untersuchungen über Pteropoden und Heteropoden, pl. v. fig. 1.

though the tentacles are not shown in the latter. On the margin of the fins the animal has five very characteristic indentations, which escaped the notice of van Beneden but are shown in the drawing of Forskål. Krohn regarded these as characteristic of a particular species, *Tiedemannia creniptera*, distinct from the *Tiedemannia "napolitana"* of Delle Chiaje and van Beneden; but he has subsequently acknowledged the identity of the two forms. The shell appears smooth in small specimens, but bears in the large forms regular tubercles, which are, however, less developed than those of *Gleba spectabilis*.

Habitat.—Mediterranean; Nice, Naples, Messina.

Some remains of a species of *Gleba* with a long proboscis were found in the Atlantic, lat. 24° to 25° N., long. 32° to 33° W. (*fide* Boas),[1] and previously to this Krohn observed at Tenerife larvæ of *Tiedemannia* which he named *neapolitana*.[2] Possibly this was the Mediterranean species, or one very nearly related to it.

2. *Gleba chrysosticta* (Krohn).

Tiedemannia chrysostica, Krohn, MS., in Troschel, Beiträge zur Kenntniss der Pteropoda, Archiv f. Naturgesch., 1854, Bd. i. p. 218.

According to Krohn, Troschel, and Gegenbaur, this species differs from the preceding, which it resembles in size, in having a shorter proboscis and golden spots on the integument. But there are no drawings of this species, and the descriptions do not say whether the proboscis is very broad, nor whether there are indentations on the distal edge of the fins. Notwithstanding the courteous search made by Dr. Jules Barrois at Villefranche and by Professor Nicholas Kleinenberg at Messina, I have unfortunately been unable to procure specimens which would have enabled me to complete the diagnosis of this form.

Habitat.—Mediterranean; Messina (Krohn, Troschel, Gegenbaur), Villefranche (Paneth).[3]

*3. *Gleba spectabilis* (Dall).

1872. *Corolla spectabilis*, Dall, Description of sixty new forms of Molluscs from the West Coast of North America and the North Pacific Ocean, Amer. Journ. of Conch., vol. vii. p. 137.

Characters and Description.—The animal has a short proboscis, which is very broad, especially towards its free extremity; the fin is subtriangular, with no indentations on the distal edge.

Dall has established for this form the new genus *Corolla* on account of the following characteristics:—the pendent visceral mass and absence of shell. Now in *Gleba* ("*Tiedemannia napolitana*" for example), when the shell has fallen off, the

[1] Spolia atlantica, p. 141.

[2] Beiträge zur Entwickelungsgeschichte der Pteropoden und Heteropoden, p. 19.

[3] Beiträge zur Histiologie der Pteropoden und Heteropoden, *Archiv f. mikrosk. Anat.*, Bd. xxiv. p. 231, 1885.

visceral mass is pendent and then presents the aspect[1] which is seen in an unpublished drawing of *Corolla spectabilis*, kindly sent me by Mr. Wm. H. Dall. In regard to the other parts, fin, proboscis, &c., this drawing shows a structure quite analogous to the *Gleba*. *Corolla* is then simply a *Gleba* that has lost its shell. The specimen, unfortunately in a bad condition, obtained by the Challenger in the North Pacific, shows this clearly. The specimen includes not only the animal but several bits of the shell. When put together the latter corresponds to the general form of the shell of *Gleba cordata*, somewhat thicker dorsally, very thin on the ventral edge, and bearing on its surface regular and very clearly marked tubercles. Unfortunately, the damaged condition of this shell does not permit me to give a satisfactory drawing.

Mr. Wm. H. Dall has, however, abandoned the idea of his *Corolla* being entirely destitute of shell. In sending me the drawing of the animal he wrote to me that he thought *Corolla* possessed "some sort of a shell like *Cymbulia*," adding that in the region where he had captured *Corolla* he had found in his tow-net "some oval thin crystalline gelatinous slipper-shaped shells," "covered with little points." This entirely agrees with the description I have given of the debris collected by the Challenger.

Dimensions (of Challenger specimen).—Diametrical breadth of the fin a little more than 5 cm., approximate length of the shell 4 cm.

Habitat.—North-east Pacific Ocean; lat. 42° 50′ N., long. 147° 25′ W. (Dall).

Challenger Specimens.—Living specimen.

On June 29, 1875; Yokohama to Sandwich Islands; lat. 35° 49′ N., long. 171° 46′ E.

The presence of the genus *Gleba* has been recorded at other localities in the Pacific Ocean:—China Sea (Boas),[2] a form with a short proboscis; New Ireland, about 4° S., 152° W. (Quoy and Gaimard),[3]—*Cymbulia punctata*, also with a short proboscis, and recognised as *Gleba* (*Tiedemannia*) by most subsequent authors. Unfortunately these forms are too imperfectly known to be entered in the catalogue of the species.

Lastly, the Challenger Expedition has collected larval shells of *Gleba* (Pl. II. fig. 17) in the following place:—

Station 216A, February 16, 1875; north of New Guinea; lat. 20° 56′ N., long. 134° 11′ E.

Several of the young forms of Cymbuliidæ, which have lost their shells, are described as distinct species, under different generic names, and some of these probably belong to the genus *Gleba*.

[1] Van Beneden, Exercices Zootomiques, *Mém. Acad. Sci. Bruxelles*, t. xii. pl. ii. fig. 1.

[2] Spolia atlantica, p. 141.

[3] Voyage de découvertes de l'Astrolabe, Zoologie, t. ii. p. 377, pl. xxvii. figs. 35, 36.

Cymbulia radiata (Quoy and Gaimard,[1] from Amboina). Figure 33 represents a somewhat advanced stage. Gegenbaur and Adams have recognised it as a *Gleba*.

Cymbulia cirroptera, Gegenbaur,[2] from Messina. Lastly, *Tiedemannia scyllæ*, Troschel,[3] and *Tiedemannia charybdis*, Troschel,[4] are also certainly young stages of *Gleba*, as indeed Troschel himself suspected. But in regard to all these young stages, observations are as yet too insufficient to enable one to determine with certainty the adult forms to which they belong.

SUMMARY.

As the result of the preceding survey of the system of the Thecosomata, forty-two species may be recognised, and these are distributed in the following manner :—

Genera.	Species.
Limacina,	10
Peraclis,	2
Clio, subgenus *Creseis*,	4
„ *Hyalocylix*,	1
„ *Styliola*,	1
„ *Clio, s. str.*,	8
Cuvierina,	1
Cavolinia,	8
Cymbulia,	2
Cymbuliopsis,	2
Gleba,	3
8	42

Of these forty-two species, there are only five which I have not been able to study myself, and only nine which have not been collected by the Challenger.

[1] Voyage de découvertes de l'Astrolabe, Zoologie, t. ii. p. 375, pl. xxvii. figs. 33, 34.
[2] Untersuchungen über Pteropoden und Heteropoden, p. 53, pl. iii. fig. 21.
[3] Beiträge zur Kenntniss der Pteropoden, *Archiv f. Naturgesch.*, 1854, Bd. i. p. 219, pl. ix. figs. 12, 13.
[4] *Ibid.*, p. 220, pl. ix. figs. 14, 15.

The expedition has thus collected about 75 per cent. of known species, and if in this group it has only discovered a single new species, it has furnished numerous particulars relating to the geographical distribution both at the surface and in the deposits of the deep sea.

From a systematic point of view the most complete results are those which refer to the family Limacinidæ, the species of which are now clearly defined. The genus *Peraclis*, hitherto mistaken, has been studied and definitely re-established, an important fact in view of the light which the knowledge of this genus sheds on the relations of the Thecosomata to one another and to other Molluscs. In short, the classification of the family Cymbuliidæ has been defined as far as is meanwhile possible.

The anatomical results of the study of the Thecosomata are as important as those which were obtained from the study of the Gymnosomata, and, along with the latter, render it possible to determine the real affinities of the Pteropods, as will be shown in the third part of this Report.

GEOGRAPHICAL DISTRIBUTION.

A. STATION LIST OF THE THECOSOMATOUS PTEROPODA OF THE CHALLENGER EXPEDITION.

I. Stations where Living Specimens were collected by Trawling or Dredging.

Station VIIf. February 2, 1873; off Madeira; lat. 32° 27′ 0″ N., long. 16° 40′ 30″ W.; surface temperature, 63° F.

Clio (Creseis) acicula.
Cavolinia trispinosa.
Cavolinia globulosa.

On April 14, 1873; off Bermuda; lat. 32° 18′ N., long. 64° 53′ W.

Cavolinia longirostris.

Station 53. May 26, 1873; Halifax to Bermuda; lat. 36° 30′ N., long. 63° 40′ W.; surface temperature, 73° F.

Cuvierina columnella.

Station 63. June 19, 1873; Bermuda to Azores; lat. 35° 29′ N., long. 50° 53′ W.; surface temperature, 71° F.

Clio (Creseis) acicula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.

Station 81. July 13, 1873; Azores to Madeira; lat. 34° 11′ N., long. 19° 52′ W.; surface temperature, 71° F.

Clio (Creseis) acicula.

Station 100. August 16, 1873; St. Vincent to St. Paul's Rocks; lat. 7° 1′ N., long. 15° 55′ W.; surface temperature, 79° F.

Cavolinia uncinata.

Station 106. August 25, 1873; St. Vincent to St. Paul's Rocks; lat. 1° 47′ N., long. 24° 26′ W.; surface temperature, 78°·8 F.

Clio (Creseis) virgula. | *Cavolinia longirostris.*

Near Station 129. September 19, 1873; off Bahia; lat. 19° 6′ S., long. 35° 40′ W.; surface temperature, 74° F.

Cavolinia uncinata. | *Cavolinia inflexa.*

Station 142. December 18, 1873; Cape of Good Hope to parallel of 46° S.; lat. 35° 4′ S., long. 18° 37′ E.; surface temperature, 65°·5 F.

Limacina inflata. | *Clio pyramidata.*
Cavolinia inflexa.

Station 143. December 19, 1873; Cape of Good Hope to parallel of 46° S.; lat. 36° 48′ S., long. 19° 24′ E.; surface temperature, 73° F.

Cavolinia inflexa.

Station 146. December 28, 1873; Marion Island to the Crozets; lat. 46° 46′ S., long. 45° 31′ E.; surface temperature, 43° F.

Limacina australis.

Station 149. January 9, 1874; at Kerguelen Island; lat. 49° 8′ S., long. 70° 12′ E.; surface temperature, 40° F. (?).

Limacina australis.

Station 150. February 2, 1874; Heard Island; lat. 52° 4′ S., long. 71° 22′ E.; surface temperature, 37°·5 F.

Limacina australis. | *Clio sulcata.*

Station 153. February 14, 1874; in vicinity of Antarctic ice; lat. 65° 42′ S., long. 79° 49′ E.; surface temperature, 29°·5 F.

Limacina antarctica.

Between Stations 154 and 155. February 21, 1874; in vicinity of Antarctic ice; lat. 63° 30′ S., long. 89° 8′ E.; surface temperature, 32° F.

Limacina australis. | *Clio sulcata.*

Station 156. February 26, 1874; in vicinity of Antarctic ice; lat. 62° 26′ S., long. 95° 44′ E.; surface temperature, 33° F.

Clio sulcata.

Station 159. March 10, 1874; Termination land to Melbourne; lat. 47° 25′ S., long. 130° 22′ E.; surface temperature, 51°·5 F.

Clio australis.

On March 15, 1874; off Melbourne; lat. 39° 45′ S., long. 40° 40′ E.; surface temperature, 59° F.

Clio (Styliola) subula.

Clio pyramidata.

On March 16, 1874; off Melbourne; lat. 39° 22′ S., long. 142° 22′ E.; surface temperature, 62° F.

Clio (Styliola) subula.

Between Stations 162 and 163. April 3, 1874; Melbourne to Sydney; lat. 38° 7′ S., long. 149° 18′ E.; surface temperature, 65° F.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Cavolinia trispinosa (young, as "*Cleodora compressa*").
Cavolinia longirostris.

Station 163. April 4, 1874; Melbourne to Sydney; lat. 36° 57′ S., long. 150° 34′ E.; surface temperature, 72° F.

Limacina bulimoides.

Station 164a. June 13, 1874; off Sydney; lat. 34° 9′ S., long. 151° 55′ E.; surface temperature, 70°·2 F.

Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Styliola) subula.
Cavolinia inflexa (young, as "*Hyalæa depressa*").

Station 175. August 12, 1874; Fiji to Raine Island; lat. 19° 2′ S., long. 177° 10′ E.; surface temperature, 77°·5 F.

Limacina inflata.
Limacina lesueuri.
Limacina bulimoides.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia quadridentata.
Cavolinia longirostris.

Cavolinia inflexa.

STATION 181. August 25, 1874; Fiji to Raine Island; lat. 13° 50′ S., long. 151° 49′ E.; surface temperature, 80° F.

Limacina inflata.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio chaptali.
Cuvierina columnella.
Cavolinia trispinosa (and young, as "*Cleodora compressa*").
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia inflexa.

Near Station 190. September 12, 1874; south of Arrou Islands; lat. 8° 56′ S., long. 135° 7′ E.; surface temperature, 79° F.

Clio (Creseis) acicula.

STATION 200. October 23, 1874; Amboina to Samboangan; lat. 6° 47′ N., long. 122° 28′ E.; surface temperature, 84° F.

Clio (Creseis) acicula.
Clio (Hyalocylix) striata.

STATION 201. October 26, 1874; Samboangan to Manila; lat. 7° 3′ N., long. 121° 48′ E.; surface temperature, 83° F.

Limacina inflata.
Limacina bulimoides.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.

STATION 209. January 22, 1875; Manila to Samboangan; lat. 10° 14′ N., long. 123° 54′ E.; surface temperature, 81° F.

Clio (Creseis) virgula.
Clio (Creseis) acicula.
Cavolinia longirostris.

On February 5, 1875; at Samboangan; surface temperature, 82° F.

Clio (Creseis) virgula.
Clio (Creseis) acicula.

On February 6, 1875; at Samboangan; lat. 6° 40′ N., long. 122° 57′ E.; surface temperature, 81° F.

Clio (Creseis) virgula.
Clio (Creseis) acicula.
Cavolinia globulosa.

STATION 213. February 8, 1875; Samboangan to New Guinea; lat. 5° 47′ N., long. 124° 1′ E.; surface temperature, 81° F.

Cavolinia longirostris.

STATION 216A. February 16, 1875; north of New Guinea; lat. 2° 56′ N., long. 134° 11′ E.; surface temperature, 82° F.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio balantium.
Cuvierina columnella.
Cavolinia quadridentata.
Cavolinia longirostris (young, as *Hyalæa lævigata*).
Cavolinia globulosa.
Fry of *Cymbulia* and *Gleba.*

Between Stations 229 and 230. April 3, 1875; Admiralty Islands to Yokohama; lat. 24° 49′ N., long. 138° 34′ E.; surface temperature, 71° F.

Clio (Creseis) virgula.
Clio (Styliola) subula.
Cavolinia gibbosa.

Near Station 230. April 4, 1875; Admiralty Islands to Yokohama; lat. 25° 33′ N., long. 137° 57′ E.; surface temperature, 69° F.

Clio (Styliola) subula.
Clio cuspidata.
Cavolinia gibbosa.
Cavolinia inflexa.

STATION 230. April 5, 1875; Admiralty Islands to Yokohama; lat. 26° 29′ N., long. 137° 57′ E.; surface temperature, 69° F.

Clio (Creseis) virgula.
Clio (Hyalocylix) striata.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia inflexa.

On May 4, 1875; at Yokohama; surface temperature, 60° F.

Cavolinia inflexa (young, as "*Pleuropus pellucidus*"; *fide* Willemoes Suhm).

STATION 237. June 17, 1875; off Japan; lat. 34° 37′ N., long. 140° 32′ E.; surface temperature, 73° F.

Clio (Creseis) acicula.

STATION 241. June 23, 1875; off Japan; lat. 35° 41′ N., long. 157° 42′ E.; surface temperature, 69°·2 F.

Cavolinia tridentata.

STATION 243. June 26, 1875; Yokohama to Sandwich Islands; lat. 35° 24′ N., long. 166° 35′ E.; surface temperature, 71° F.

Limacina bulimoides.

On June 29, 1875 ; Yokohama to Sandwich Islands ; lat. 35° 49′ N., long. 171° 46′ E.; surface temperature, 69° F.

Gleba spectabilis.

Between Stations 247 and 248. July 4, 1875 ; Yokohama to Sandwich Islands ; lat. 36° 42′ N., long. 179° 50′ W.; surface temperature, 70° F.

Limacina lesueuri.
Limacina bulimoides.
Clio (Hyalocylix) striata.
Cavolinia trispinosa (young, as "*Cleodora compressa*").
Cavolinia inflexa (young, as "*Hyalæa depressa*").

Station 249. July 7, 1875 ; Yokohama to Sandwich Islands ; lat. 37° 59′ N., long. 171° 48′ W.; surface temperature, 65°·2 F.

Cavolinia gibbosa.

Station 251. July 10, 1875 ; Yokohama to Sandwich Islands ; lat. 37° 37′ N., long. 163° 26′ W.; surface temperature, 65° F.

Clio pyramidata.

Station 254. July 17, 1875 ; Yokohama to Sandwich Islands ; lat. 35° 13′ N., long. 154° 43′ W.; surface temperature, 72° F.

Clio (Hyalocylix) striata.
Clio pyramidata.
Clio cuspidata.
Cavolinia tridentata.
Cymbulia sp.

Station 256. July 21, 1875 ; Yokohama to Sandwich Islands ; lat. 30° 22′ N., long. 154° 56′ W.; surface temperature, 74° F.

Clio (Creseis) acicula.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia inflexa.

Between Stations 264 and 265. August 24, 1875 ; Sandwich Islands to Tahiti ; lat. 13° 15′ N., long. 152° 2′ W.; surface temperature, 78° F.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Peraclis reticulata.
Clio (Creseis) virgula.
Clio (Hyalocylix) striata.

Station 269. September 2, 1875 ; Sandwich Islands to Tahiti ; lat. 5° 54′ N., long. 147° 2′ W.; surface temperature, 81°·2 F.

Cavolinia longirostris.

STATION 272. September 8, 1875; Sandwich Islands to Tahiti; lat. 3° 48′ S., long. 152° 56′ W.; surface temperature, 79° F.

Limacina lesueuri.

"August—September 1875," without indication of Station, in the trip from Sandwich Islands to Tahiti.

Clio (Creseis) acicula. | *Cavolinia longirostris.*
Cavolinia quadridentata. | *Cavolinia gibbosa.*
Cavolinia uncinata.

STATION 280. October 4, 1875; Tahiti to Valparaiso; lat. 18° 40′ S., long. 149° 52′ W.; surface temperature, 77°·2 F.

Cuvierina columnella.

STATION 282. October 7, 1875; Tahiti to Valparaiso; lat. 23° 46′ S., long. 149° 59′ W.; surface temperature, 73°·2 F.

Clio (Hyalocylix) striata.

STATION 288. October 21, 1875; Tahiti to Valparaiso; lat. 40° 3′ S., long. 132° 58′ W.; surface temperature, 54°·5 F.

Cuvierina columnella.

Near Station 288. October 22, 1875; Tahiti to Valparaiso; lat. 40° 0′ S., long. 131° 36′ W.; surface temperature, 54° F.

Cuvierina columnella.

Between Stations 292 and 293. October 31, 1875; Tahiti to Valparaiso; lat. 38° 50′ S., long. 108° 6′ W.; surface temperature, 54° F.

Clio (Creseis) acicula. | *Cavolinia longirostris.*

STATION 293. November 1, 1875; Tahiti to Valparaiso; lat. 39° 4′ S., long. 105° 5′ W.; surface temperature, 53°·7 F.

Clio (Styliola) subula. | *Clio pyramidata.*

STATION 294. November 3, 1875; Tahiti to Valparaiso; lat. 39° 22′ S., long. 98° 46′ W.; surface temperature, 57°·5 F.

Cuvierina columnella.

STATION 295. November 5, 1875; Tahiti to Valparaiso; lat. 38° 7′ S., long. 94° 4′ W.; surface temperature, 58°·5 F.

Cavolinia inflexa.

STATION 299. December 14, 1875; Valparaiso to Gulf of Penas; lat. 33° 31′ S., long. 74° 43′ W.; surface temperature, 62° F.

Clio (Creseis) virgula.

STATION 323. February 28, 1876; Rio de la Plata to Tristan da Cunha; lat. 35° 39′ S., long. 50° 47′ W.; surface temperature, 73°·5 F.

Clio (Creseis) acicula.

STATION 326. March 3, 1876; Rio de la Plata to Tristan da Cunha; lat. 37° 3′ S., long. 44° 17′ W.; surface temperature, 67°·8 F.

Clio (Creseis) acicula.

STATION 327. March 4, 1876; Rio de la Plata to Tristan da Cunha; lat. 36° 48′ S., long. 42° 45° W.; surface temperature, 70°·2 F.

Clio (Creseis) acicula.
Cavolinia inflexa.

STATION 332. March 10, 1876; Rio de la Plata to Tristan da Cunha; lat. 37° 29′ S., long. 27° 31′ W.; surface temperature, 64° F.

Clio pyramidata.

STATION 337. March 19, 1876; Tristan da Cunha to Ascension Island; lat. 24° 38′ N., long. 13° 36′ W.; surface temperature, 77° F.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Cavolinia quadridentata.

STATION 338. March 21, 1876; Tristan da Cunha to Ascension Island; lat. 21° 15′ S., long. 14° 2′ W.; surface temperature, 76°·5 F.

Cavolinia longirostris.

STATION 339. March 23, 1876; Tristan da Cunha to Ascension Island; lat. 17° 26′ S., long. 13° 52′ W.; surface temperature, 76° F.

Clio (Creseis) acicula.

STATION 345. April 4, 1876; Ascension Island to St. Vincent; lat. 5° 45′ S., long. 14° 25′ W.; surface temperature, 82°·8 F.

Cavolinia longirostris.

STATION 348. April 9, 1876; Ascension Island to St. Vincent; lat. 3° 10′ N., long. 14° 51′ W.; surface temperature, 84° F.

Clio (Creseis) virgula.

STATION 349. April 10, 1876; Ascension Island to St. Vincent; lat. 5° 28′ N., long. 14° 38′ W.; surface temperature, 83°·5 F.

Clio (Creseis) acicula. | *Cavolinia longirostris.*

STATION 350. April 11, 1876; Ascension Island to St. Vincent; lat. 7° 33′ N., long. 15° 16′ W.; surface temperature, 84° F.

Cavolinia inflexa (young, as "*Hyalæa depressa*").

STATION 352. April 13, 1876; Ascension Island to St. Vincent; lat. 10° 55′ N., long. 17° 46′ W.; surface temperature, 77°·7 F.

Cavolinia longirostris.

On April 26, 1876; off St. Vincent; lat. 16° 49′ N., long. 25° 14′ W.; surface temperature, 74° F.

Limacina inflata. | *Limacina bulimoides.*
Limacina lesueuri. | *Clio (Creseis) virgula.*
Clio (Creseis) acicula.

On April 28, 1876; off St. Vincent; lat. 17° 47′ N., long. 28° 28′ W.; surface temperature, 73° F.

Clio pyramidata.

On April 29, 1876; off St. Vincent; lat. 18° 8′ N., long. 30° 5′ W.; surface temperature, 73° F.

Clio (Creseis) virgula. | *Clio (Styliola) subula.*
Clio (Creseis) acicula. | *Cavolinia quadridentata.*

STATION 353. May 3, 1876; St. Vincent towards Azores; lat. 26° 21′ N., long. 33° 37′ W.; surface temperature, 70°·7 F.

Clio (Creseis) acicula. | *Cavolinia quadridentata.*
Cavolinia longirostris.

Near Station 354. May 7, 1876; St. Vincent towards Azores; lat. 34° 22′ N., long. 34° 23′ W.; surface temperature, 68° F.

Limacina lesueuri.	*Clio (Styliola) subula.*
Limacina bulimoides.	*Cuvierina columnella.*

On May 12, 1876; off the Azores; lat. 42° 52′ N., long. 28° 54′ W.; surface temperature, 59° F.

Clio (Hyalocylix) striata.	*Clio pyramidata.*

II. Principal Stations at which Shells of Thecosomata were found in the Deposits.

Shells of Thecosomata are never found in sediments from a depth greater than 2000 fathoms. The greatest depth from which they have been procured, as far as I am aware, is 1950 fathoms (Station 35c).

This absence of the calcareous shells of Thecosomata from the greater depths is due, according to Mr. John Murray, to the greater proportion of carbonic acid gas in the water at those depths and to the more rapid solution of these shells in sea water under great pressure. This results in the solution of the delicate Pteropod shells at lesser depths than many other more massive pelagic shells.

The Stations cited below are the principal sources of the deposits which I have examined. The list of Pteropoda Thecosomata (as well as of other organisms) found in the other deposits will be found in the Report on the Deep-Sea Deposits by Mr. John Murray and Mr. A. Renard.

It is of importance to inquire whether the distribution of the shells of different species found in the bottom-deposits corresponds to the actual distribution of the living specimens, or in other words whether the superficial distribution has or has not altered since the time when the shells began to be deposited on the bottom, and whether any species represented by empty shells in a given deposit are also found in actual life at the surface of the same locality.

This inquiry has hitherto yielded but little positive result. The most striking fact concerns the distribution of *Limacina bulimoides*, which is not now known as a living form in the Mediterranean or in the North Atlantic north of 39° N. lat., but is found in the deep bottom-deposits of both these seas. In the North Atlantic *Peraclis reticulata* seemed also to occur further to the north in the deposits than at the surface. It must be noted that these two forms are species frequenting the warmer waters. On the other hand *Limacina retroversa*, which frequents the colder waters, extends somewhat further south in the deposits than at the surface.

The investigation of a larger number of deposits will probably reveal other facts of a like nature.

STATION VIII. February 12, 1873; off the Canary Islands; lat. 28° 3′ 15″ N., long. 17° 27′ 0″ W.; depth, 620 fathoms; bottom, volcanic mud.

Limacina inflata.
Limacina lesueuri.
Limacina bulimoides.
Peraclis bispinosa.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia quadridentata.
Cavolinia inflexa.

STATION 3. February 18, 1873; Tenerife to Sombrero Island; lat. 25° 45′ N., long. 20° 14′ W.; depth, 1529 fathoms; bottom, hard ground.

Limacina inflata.
Limacina lesueuri.
Limacina bulimoides.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia quadridentata.
Cavolinia inflexa.

STATION 23. March 15, 1873; off Sombrero Island; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

Limacina inflata.
Limacina triacantha.
Limacina lesueuri.
Limacina bulimoides.
Peraclis reticulata.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Styliola) subula.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia uncinata.
Cavolinia inflexa.

STATION 24. March 25, 1873; off Culebra Island; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze.

Limacina inflata.
Limacina triacantha.
Limacina lesueuri.
Limacina bulimoides.
Peraclis reticulata.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia uncinata.
Cavolinia inflexa.

STATION 32B. April 3, 1873; St. Thomas to Bermuda; lat. 32° 10′ N., long. 64° 52′ W.; depth, 950 fathoms; bottom, coral mud.

Limacina inflata.
Limacina bulimoides.

STATION 33. April 4, 1873; off Bermuda; lat. 32° 21′ 30″ N., long. 64° 35′ 55″ W.; depth, 435 fathoms; bottom, coral mud.

Limacina inflata.
Limacina triacantha.
Limacina lesueuri.
Limacina bulimoides.
Peraclis reticulata.
Peraclis bispinosa.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia inflexa.

STATION 35C. April 22, 1873; off Bermuda; lat. 32° 15′ N., long. 65° 8′ W.; depth, 1950 fathoms; bottom, Globigerina ooze.

Clio (Creseis) acicula.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia trispinosa.

STATION 70. June 26, 1873; Bermuda to Azores; lat. 38° 25′ N., long. 35° 50′ W.; depth, 1675 fathoms; bottom, Globigerina ooze.

Cavolinia trispinosa.
Cavolinia gibbosa.

STATION 75. July 2, 1873; off Fayal (Azores); lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud.

Limacina inflata.
Peraclis bispinosa.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia trispinosa.

STATION 76. July 3, 1873; off the Azores; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze.

Limacina inflata.
Peraclis bispinosa.
Clio pyramidata.
Cavolinia trispinosa.

STATION 78. July 10, 1873; off the Azores; lat. 37° 26′ N., long. 25° 13′ W.; depth, 1000 fathoms; bottom, volcanic mud.

Limacina inflata.
Limacina triacantha.
Limacina helicoides.
Peraclis reticulata.
Peraclis bispinosa.
Clio (Cresceis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio polita.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia inflexa.

STATION 85. July 19, 1873; off Palma Island (Canaries); lat. 28° 42′ N., long. 18° 6′ W.; depth, 1125 fathoms; bottom, volcanic mud.

Limacina inflata.
Limacina triacantha.
Limacina lesueuri.
Limacina bulimoides.
Peraclis reticulata.
Peraclis bispinosa.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio polita.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia gibbosa.
Cavolinia uncinata.
Cavolinia inflexa.

STATION 120. September 9, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 8° 37′ S., long. 34° 28′ W.; depth, 675 fathoms; bottom, red mud.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio polita.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.

STATION 122. September 10, 1873; off the coast of South America, between Pernambuco and Bahia; lat. 9° 5′ S., long. 34° 50′ W.; depth, 350 fathoms; bottom, red mud.

Limacina inflata.
Limacina lesueuri.
Limacina bulimoides.
Peraclis reticulata.
Peraclis bispinosa.
Clio (Creseis) acicula.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia uncinata.
Cavolinia inflexa.

STATION 164. June 12, 1874; off Sydney; lat. 34° 8′ S., long. 152° 0′ E.; depth, 950 fathoms; bottom, green mud.

Clio (Styliola) subula.
Clio pyramidata.
Cavolinia trispinosa.

STATION 174. August 3, 1874; off Kandavu Island; lat. 19° 6′ 0″ S., long. 178° 14′ 20″ E.; depth, 140 fathoms; bottom, coral mud.

Limacina inflata.

STATION 185. August 31, 1874; off Raine Island; lat. 11° 35′ 25″ S., long. 144° 2′ 0″ E.; depth, 135 fathoms; bottom, coral sand.

Limacina inflata.
Limacina lesueuri.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia uncinata.
Cavolinia inflexa.

STATION 219. March 10, 1875; Admiralty Islands to Yokohama; lat. 1° 54′ 0′ S., long. 146° 39′ 40″ E.; depth, 150 fathoms; bottom, coral mud.

Limacina inflata.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Creseis) conica.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia trispinosa (young, as "*Cleodora compressa*").
Cavolinia quadridentata.
Cavolinia longirostris (young, as "*Hyalæa lævigata*").

STATION 246. July 2, 1875; Yokohama to Sandwich Islands; lat. 36° 10′ N., long. 178° 0′ E.; depth, 2050 fathoms; bottom, Globigerina ooze.

Clio pyramidata.

STATION 323. February 28, 1876; Falkland Islands to Rio de la Plata; lat. 35° 39′ S., long. 50° 47′ W.; depth, 1900 fathoms; bottom, blue mud.

Clio pyramidata.
Cavolinia inflexa.

STATION 335. March 16, 1876; Tristan da Cunha to Ascension Island; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom, Pteropod ooze.

Limacina inflata.
Clio (Styliola) subula.
Clio pyramidata.
Cavolinia trispinosa.
Cavolinia inflexa.
Cuvierina columnella.

B. GEOGRAPHICAL DISTRIBUTION OF THE GENERA.

When I indicated the geographical divisions (pelagic provinces) which might be adopted for the geographical distribution of the Gymnosomatous Pteropoda,[1] I had not been entrusted with the Systematic Report on the Thecosomata, which was still in the hands of Mr. Alfred E. Craven. Consequently these divisions were based, not on the study of all the Pteropoda, but only on the very limited group of the Gymnosomata, and therefore in circumstances very unfavourable to generalisation, and apt to lead to multiplied subdivisions.

For the sake of uniformity, however, I have here used the same subdivisions as in the case of the Gymnosomata, and it will be seen that they apply tolerably well to the Thecosomata also.

It is to be observed, in the first place, that the Thecosomata are in general more cosmopolitan than the Gymnosomata. But it is possible that, after a more complete study of the latter, certain forms may be found to be less localised.

In the Report on the Gymnosomata, the absence of materials made me wonder whether there did not exist, for the western part of the southern Atlantic, a special pelagic province (the Brazilian). The study of the Thecosomatous Pteropoda has convinced me that there is none, and that this "province" is identical in character with the South-west African. It seems advisable therefore to unite it to the latter to form a South Atlantic province, in contrast to the North Atlantic one, from which it distinctly differs in the presence of some particular species. This South Atlantic province includes the region situated to the south of the great equatorial current and to the north of 39° S.; and is traversed by the South Atlantic and by the Brazilian currents. In the diagrams

[1] Zool. Chall. Exp., pt. lviii. pp. 61, 62.

of geographical distribution the name South-west African province will therefore be replaced by that of South Atlantic.

Genera of Thecosomata have been observed in all the warm and temperate seas, that is to say, in eight out of ten pelagic provinces. In the case of several of these provinces the first mention of certain genera is due to the results of the Challenger Expedition; for example in the case of the South Atlantic, Australasian, North Pacific, and South-east Pacific.

The maximum geographical extension is found in the genus *Limacina*, as comprehended in this Report. In fact *Limacina* is not absent from any of the ten provinces which have been adopted in the Systematic Report on the Gymnosomata.

Peraclis is more local; at least it has not hitherto been observed except in the North Atlantic (including the Mediterranean), West Pacific, and South-east Pacific provinces. But it seems to me probable that it will afterwards be found in the other warm seas, at least in the South Atlantic, Indian Ocean, and Australasian provinces. (Empty shells of *Peraclis reticulata* and *Peraclis bispinosa* have already been got in sediments from the bottom of the sea, at lat. 9° 5′ S., Station 122.)

In the group of Cavoliniidæ the genera and even the subgeneric sections are almost all cosmopolitan, not being absent even in the cold provinces (Arctic and Antarctic). Thus forms of *Clio* belonging to the subgenera *Creseis*, *Hyalocylix*, and *Styliola* have been found in all the eight warm and temperate provinces.

The subgenus *Clio*, *s. str.*, although with a geographical distribution not quite so extensive as the genus *Limacina*, has been found in the eight warm and temperate, and in the two Arctic (*Clio pyramidata*) and Antarctic provinces (*Clio australis* and *Clio sulcata*).

Lastly, the geographical distribution of the genera *Cavolinia* and *Cuvierina* also extends throughout the eight warm and temperate provinces.

Leaving the calcareous-shelled Thecosomata, and passing to the Cymbuliidæ, we find that like *Peraclis* and the different genera of the Gymnosomata they have as yet been insufficiently studied. The presence of the genus *Cymbulia* has been proved in the following provinces—the North Atlantic, Indian Ocean, and Australasian; that of the genus *Cymbuliopsis* in the North Atlantic and Australasian; and that of the genus *Gleba* in the North Atlantic and Australasian.

As with the genera of Gymnosomata, I here collect the data respecting the geographical distribution of the genera of Thecosomata in a table which sums up the subject in an intelligible way. This table has been made exclusively from the study of specimens taken alive, as one cannot take into account the empty shells of the deposits in establishing the geographical distribution of pelagic animals like the Pteropoda.[1]

[1] With reference to this statement, as well as those made by Dr. Pelseener on p. 116, as to the correspondence between the distribution of pelagic organisms on the surface and their dead remains on the bottom, I may state that in almost all instances when these remains have been found on the bottom of the ocean, further researches have shown the presence of the living animals in the surface waters at all events at some period of the year.—J. M.

	Arctic.	North Atlantic.	South Atlantic.	Indian Ocean.	Austral-asian.	West Pacific.	East Aus-tralian.	North Pacific.	South-East Pacific.	Ant-arctic.
Peraclis, ...		×				×			×	
Limacina, ...	×	×	×	×	×	×	×	×	×	×
Clio (*Creseis*), . . .		×	×	×	×	×	×	×	×	
„ (*Hyalocylix*), . . .		×	×	×	×	×	×	×	×	
„ (*Styliola*), . . .		×	×	×	×	×	×	×	×	
„ *s. str.*, ...	×	×	×	×	×	×	×	×	×	×
Cuvierina, ...		×	×	×	×	×	×	×	×	
Cavolinia, ...		×	×	×	×	×	×	×	×	
Cymbulia, ...		×		×[1]	×[2]		×	×[3]		
Cymbuliopsis, . . .		×			×					
Gleba, ...		×			×[4]	×[5]		×		

C. THE SPECIES OF THECOSOMATA ARRANGED IN PROVINCES.

I. Arctic Province.

Limacina helicina.
Limacina retroversa.
Clio pyramidata.

II. North Atlantic Province.

Limacina inflata.
Limacina triacantha.
Limacina helicoides.
Limacina lesueuri.
Limacina retroversa.
Limacina trochiformis.
Limacina bulimoides.
Peraclis reticulata.
Peraclis bispinosa.
Clio (*Creseis*) *virgula.*
Clio (*Creseis*) *conica.*
Clio (*Creseis*) *acicula.*
Clio (*Hyalocylix*) *striata.*
Clio (*Styliola*) *subula.*
Clio polita.
Clio balantium.
Clio pyramidata.
Clio cuspidata.

[1] The *Cymbulia* from the Indian Ocean, figured by Macdonald, see p. 95.
[2] The larvæ of *Cymbulia* collected by the Challenger, see p. 99.
[3] The *Cymbulia* sp., collected by the Challenger, see p. 99.
[4] The larvæ of *Gleba* collected by the Challenger, see p. 104.
[5] The *Gleba* mentioned by Boas, see p. 104.

Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.
Cymbulia peroni.
Cymbuliopsis calceola.
Gleba cordata.
Gleba chrysosticta.

III. South Atlantic Province.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) conica.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio andreæ.
Clio balantium.
Clio chaptali.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.

IV. Indian Ocean Province.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio balantium.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia globulosa.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.

V. Australasian Province.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio balantium.
Clio chaptali.
Clio pyramidata.
Cuvierina columnella.

Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia globulosa.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.

Cymbuliopsis ovata.

VI. West Pacific Province.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Peraclis reticulata.
Clio (Creseis) virgula.
Clio (Creseis) conica.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia globulosa.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.

Cavolinia inflexa.

VII. East Australian Province.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia inflexa.
Cymbulia parvidentata.

VIII. North Pacific Province.

Limacina inflata.
Limacina lesueuri.
Limacina bulimoides.
Clio (Creseis) virgula.
Clio (Creseis) acicula.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Clio cuspidata.
Cuvierina columnella.
Cavolinia trispinosa.
Cavolinia quadridentata.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.

Gleba spectabilis.

IX. South-East Pacific Province.

Limacina inflata.
Limacina lesueuri.
Limacina trochiformis.
Limacina bulimoides.
Peraclis reticulata.
Clio (Creseis) virgula.
Clio (Creseis) conica.
Clio (Creseis) acicula.
Clio (Creseis) chierchiæ.
Clio (Hyalocylix) striata.
Clio (Styliola) subula.
Clio pyramidata.
Cuvierina columnella.
Cavolinia longirostris.
Cavolinia gibbosa.
Cavolinia tridentata.
Cavolinia uncinata.
Cavolinia inflexa.

X. Antarctic Province.

Limacina antarctica.
Limacina australis.
Clio australis.
Clio sulcata.

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PLATE I.

PLATE I.

Figs. 1, 2. *Limacina triacantha* (Fischer).

Fig. 1. Shell, from the aperture; magnified fourteen diameters.
Fig. 2. Shell, from the apex; magnified fourteen diameters.

Figs. 3, 4. *Limacina antarctica*, Woodward. (After Hooker's unpublished figures.)

Fig. 3. Shell, from the aperture; magnified ten diameters.
Fig. 4. Shell, from the apex; magnified five diameters.

Fig. 5. *Limacina helicoides*, Jeffreys. Shell, from the aperture; magnified eight diameters.

Fig. 6. *Limacina australis* (Eydoux and Souleyet). Shell, from the aperture; magnified eight diameters.

Figs. 7, 8. *Peraclis reticulata* (d'Orbigny).

Fig. 7. Shell (from deep-sea deposit), from the aperture; magnified twelve diameters.
Fig. 8. Operculum, from the outside. *a*, Surface of insertion.

Figs. 9, 10. *Peraclis bispinosa*, n. sp.

Fig. 9. Shell, from aperture; magnified six diameters.
Fig. 10. Shell, from apex; magnified seven diameters.

Figs. 11–14. "*Agadina*" *stimpsoni*, A. Adams.

Fig. 11. Shell, from aperture, with operculum *in situ*; magnified eighteen diameters.
Fig. 12. Shell, from apex; magnified twenty-two diameters.
Fig. 13. Animal, from left side; magnified twenty diameters. *a*, velum; *b*, visceral mass; *c*, aperture of pallial cavity; *d*, operculum; *e*, foot.
Fig. 14. Lower surface of the foot; magnified twenty diameters. *a*, operculum.

Figs. 15, 16. "*Agadina*" sp.

Fig. 15. Shell, from aperture; magnified twenty-two diameters.
Fig. 16. Shell, from umbilicus; magnified twenty-two diameters.

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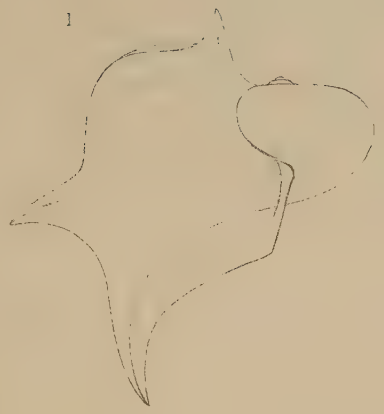

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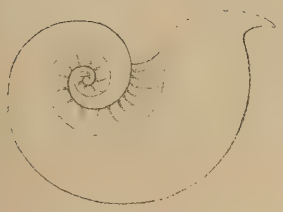

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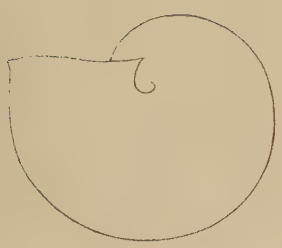

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PLATE II.

PLATE II.

Figs. 1, 2. *Clio* (*Creseis*) *conica* (Eschscholtz).

Fig. 1. Shell, from left side; magnified ten diameters.
Fig. 2. Embryonic shell, from left side.

Fig. 3. *Clio* (*Hyalocylix*) *striata* (Rang). Embryonic shell, from ventral surface.

Figs. 4–6. *Clio polita* (Craven, MS.).

Fig. 4. Shell, from right side; magnified six diameters.
Fig. 5. Shell, from dorsal surface; magnified six diameters.
Fig. 6. Embryonic shell, from ventral surface.

Fig. 7. *Clio chaptali* (Souleyet). Embryonic shell, from ventral surface.

Fig. 8. *Clio australis* (d'Orbigny). Embryonic shell, from ventral surface.

Figs. 9–11. *Clio sulcata* (Pfeffer).

Fig. 9. Shell, from right side; magnified four diameters.
Fig. 10. Shell, from dorsal surface; magnified four diameters.
Fig. 11. Embryonic shell, from ventral surface.

Figs. 12, 13. *Cymbulia parvidentata*, n. sp.

Fig. 12. Shell, from anterior side; magnified two diameters.
Fig. 13. Shell, from posterior side; magnified two diameters.

Fig. 14. Larval shell of *Cymbulia*, from aperture, with operculum *in situ*.

Figs. 15, 16. *Cymbuliopsis ovata* (Quoy and Gaimard).

Fig. 15. Shell, from anterior side; magnified two diameters.
Fig. 16. Shell, from left side; magnified two diameters.

Fig. 17. Larval shell of *Gleba*, from aperture.

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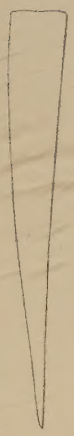

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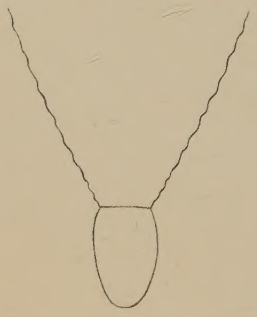

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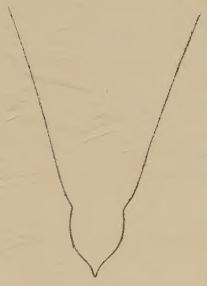

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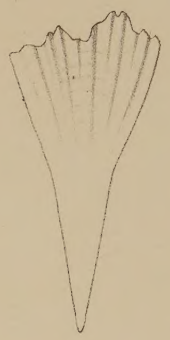

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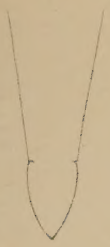

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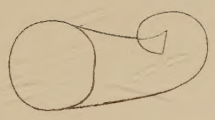

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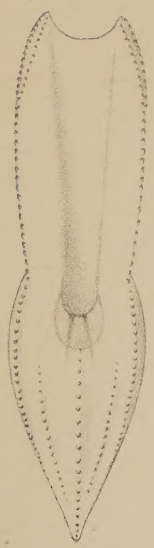

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